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POWER PLANT IN A MECHANIC ARTS HIGH SCHOOL

By C. L. HUBBARD

THE power plant recently installed in the enlarged Mechanic Arts High School, Boston, is a good illustration of a compact and well arranged layout for a public building where restricted space and quietness of action are among the requirements.

General Arrangement

The relative locations of the different parts of the equipment are shown in Fig. 1. Steam for power, heating and ventilation is furnished by a battery of 3 142-hp. Heine boilers.

The engine room contains 2 direct-connected generating sets, each of 100 kw. capacity, and in addition to these there is the usual auxiliary equipment of pumps, feed water heater, receiving tank, steam and oil separators, etc.

The loop or circuit system of piping is used for the high pressure work, and from this branches lead to the engines, pumps and main heating system, the latter being through a pressure-reducing valve provided with a by-pass. All connections with the 10-in. circuit header are in the top and it is drained at 4 points through a high-pressure trap to the receiving tank. Three of the drip connections are taken from points directly under the lead connections from the boilers, and the fourth from the opposite end of the loop near the offtakes to the engines.

The main exhaust runs in a trench beneath the engine room floor to the boiler room, where it rises and is carried overhead to a combined oil separator and receiving tank; here it drops and passes through the separator, which is contained inside the tank. The purified steam then passes into an uptake having 3 branches, one leading to the feed-water heater, one to the low-pressure heating main, and one outboard through a back-pressure valve.

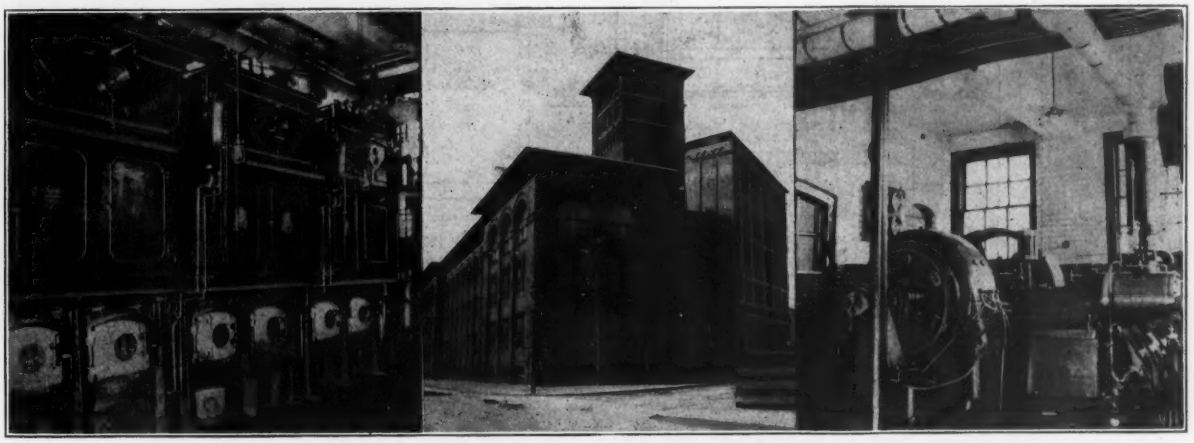


FIG. 5. VIEWS OF BUILDING, BOILER AND ENGINE ROOMS MECHANIC ARTS HIGH SCHOOL

A by-pass is provided around the oil separator for use during repairs or when exhausting outboard in the summertime. The arrangement of this piping is made clearer by reference to Fig. 2, which shows an elevation of the boilers and receiving tank and the connecting piping.

The rear of the boilers, together with the smoke connections and dampers are shown in Fig. 3. A sec-

tion through the boiler and engine rooms is shown in Fig. 4. This illustrates the supply and exhaust piping to the engines, and the method of supporting the 10-in. exhaust risers. All of the heavy piping, both for supply and exhaust is supported from the basement floor by means of columns and cross beams. The reason for this is to avoid all vibration which might be communicated to the rooms above from the high-speed engines. Having described the plant in a general way, the different parts will now be taken up in some detail as a possible guide in the design of similar work.

Boilers

These are the Heine, front fired, water-tube type, rated at 142 hp. each, on a basis of 10 sq. ft. of heating surface per horsepower. Each boiler contains 77 tubes, 3.5 in. in diameter and 18 ft. long. These are expanded into the tube sheets, and over the ends of each is a hand hole with a removable cast iron plate for reaching the tube in case repairing is necessary or for cleaning. The steam and water drums are 36 in. in diameter by 21 ft. 4.5 in. in length, of ⅜-in. flange steel conforming to the specifications of the American Boiler Manufacturing Association. The heads are 1.5 in. thick, dished to the segment of a sphere, the radius of which is equal to the diameter of the drum. A manhole 11 by 15 in. is provided in the rear head for access to the drum. A baffle plate is placed over the opening from the front water leg, and in addition to this, the nozzle is provided with a dry pan of ample size to prevent the carrying over of spray into the piping.

The nozzles, one 7 and the other 3.5 in. in diameter, are of flanged welded steel. Within the water drum is a mud drum with a special 3.5-in. brass blowoff connection through the rear head.

Boiler fronts are of ornamental cast iron, containing 2 fire-doors, 2 ash-pit doors and a double tube door. Each furnace is provided with a shaking grate 5 ft. wide by 6 ft. in length and arranged for burning either soft coal or screenings. All iron work in the construction of the boilers is protected upon the outside by a heavy coat of red lead and in addition to this all exposed iron work was painted after setting with black asphaltum and the raised parts on the fronts touched up with gold bronze.

The specifications required that the drum and water legs should be subjected to a hydrostatic pressure of 250 lb. per sq. in., and that the tubes should be separately tested to 500 lb. per sq. in. before leaving the works. In addition to this the boilers were tested in a similar manner and made tight at 225 lb. pressure after erection and are guaranteed to withstand a working steam pressure of 150 lb. if desired.

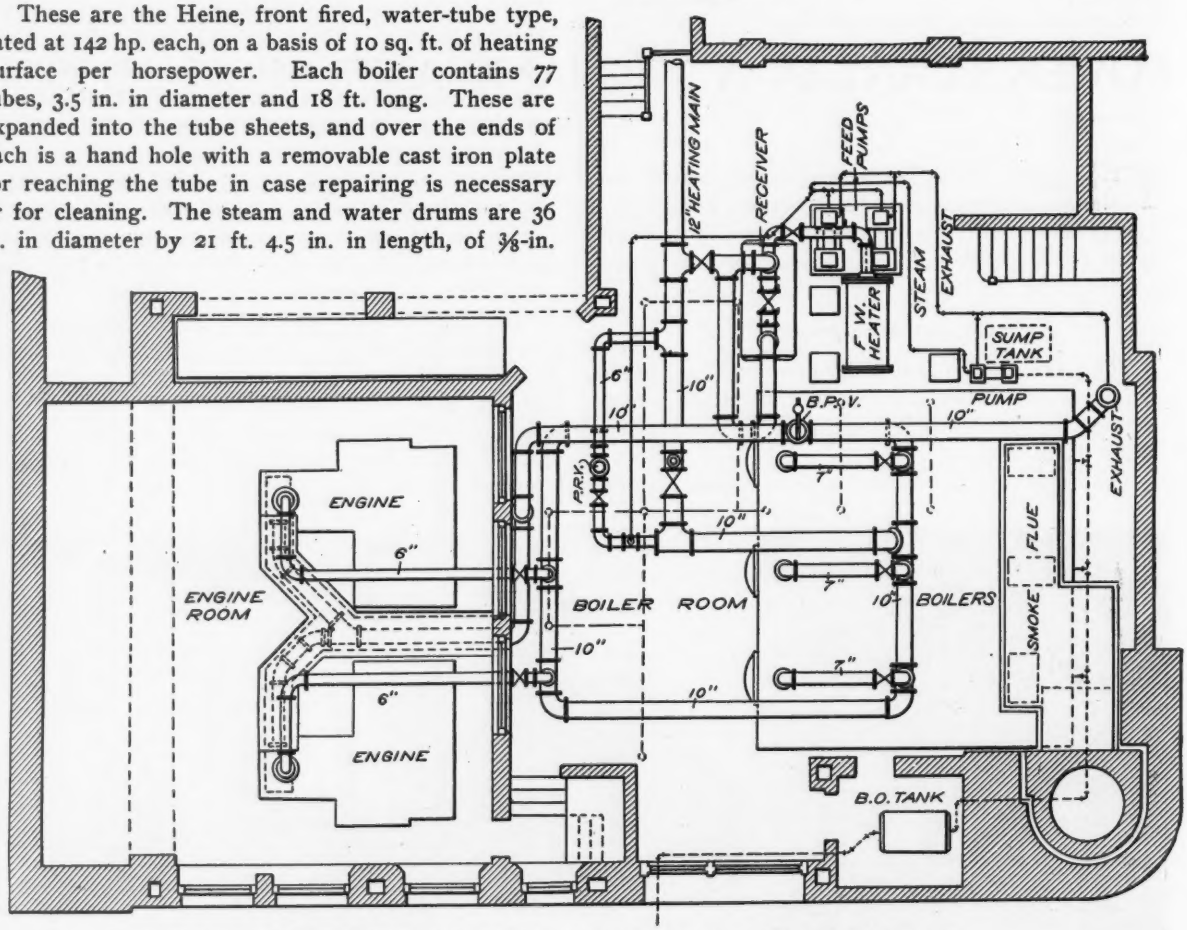


FIG. I. ARRANGEMENT OF MACHINERY IN MECHANIC ARTS HIGH SCHOOL PLANT

Fittings, Smoke Connections, Etc.

Each boiler is equipped with a 4-in. pop safety valve of the Crosby make, set for 100 lb. working pressure; an 8.5-in. Ashton pressure gage reading to

200 lb., a high and low water alarm; gage cocks; a Huyette quick-closing water gage; and special blow-off valves furnished by the boiler manufacturers.

The smoke connections are of No. 10 iron and connect the boilers with the chimney as shown in Figs. 1 and 3. The uptake from each boiler is provided with an adjustable regulating damper, and the main pipe with a balanced damper resting on roller bearings. This is attached to a Locke graduated damper regulator set to maintain a steady pressure on the boilers of 100 lb. The furnaces are also equipped with hand-operated Sidney Smith smoke preventing devices, not shown in the plans, by which jets of steam

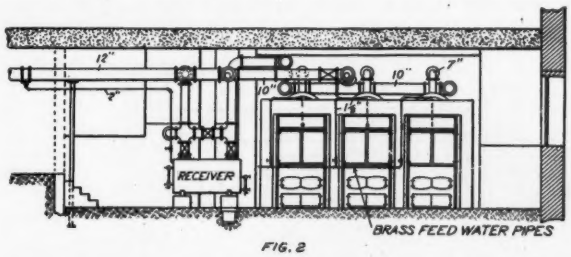


FIG. 2. BOILERS, RECEIVING TANK AND CONNECTING PIPING

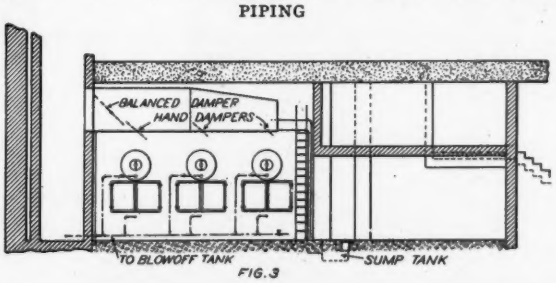


FIG. 3. REAR OF BOILERS AND SMOKE CONNECTIONS

and air are blown into each furnace over the firedoor for a short time after putting on fresh coal.

In addition to the boiler feed pumps, to be mentioned later, an injector, having a 2-in. suction, is connected with the main feed pipe. All piping connecting to the injector is of polished brass. A polished slate gage board in the engine room contains 5 8.5-in. gages of the Ashton make, for indicating the following pressures: boiler, heating, city water, high pressure steam to laboratory, and air pressure. In addition to the above the board contains an 8-day clock with an 8-in. dial to correspond with the gages.

Two recording gages are placed in the head masters' room; one for indicating the boiler pressure and the other for the heating system. Two additional 8.5-in. gages are placed in the boiler room; one for indicating the pressure in the heating system and to be used when setting the reducing valve, and the other for indicating pressure on the line leading to glue pots in the carpenter shops. A special low-pressure Crosby safety-valve, set at 15 lb., is placed in the heating main just beyond the pressure reducing valve to serve as an alarm in case this valve should fail to work and the pressure rise above the normal.

Tanks

The blowoff tank, shown in Fig. 1, is 30 in. in diameter by 48 in. in length, made of ⅜-in. hard tank iron with heads of 0.5-in. flanged iron. It is provided with the usual inlet, outlet and vapor pipes, and also has a 0.75-in. cold water connection. This tank is supported on wrought-iron cradles as shown in Fig. 2A.

A sump tank 24 by 30 by 48 in. in size of ⅝-in. cast iron takes all drainage from the boiler room which is to be passed directly into the sewer. This is provided with a 4-in. vapor pipe connected with the smoke flue, and has a copper float with suitable lever

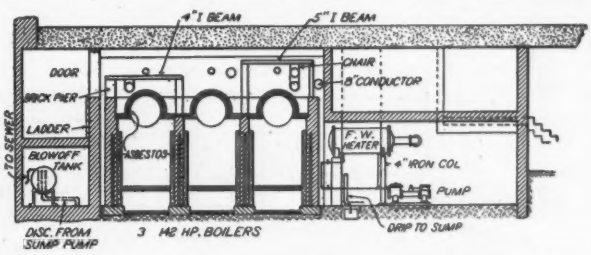


FIG. 2A. SECTION THROUGH BOILERROOM

connections for operating automatically a steam pump to be mentioned later.

Engines

The engines, 2 in number, are simple horizontal high-speed, noncondensing, made by the Ames Iron Works, direct connected to General Electric generators. They operate at an approximate speed of 270 r. p. m. under an initial pressure of 100 lb. and at 0.25 cutoff. Regulation is by means of a cutoff fly-wheel governor. The specifications require that the drop in speed from no load to 25 per cent overload shall not exceed 2.5 per cent of the speed at no load; and further that this condition shall be maintained with the steam pressures ranging from 80 to 120 lb. The best of materials are called for in the construction of the engines. All forgings are to be of open hearth steel or hammered iron, and castings of a hard close-grained mixture of charcoal iron. The cylinders are of sufficient weight to carry the required pressure after being rebored twice, and are insulated with magnesia under an iron casing.

The shaft is of the best quality hammered steel and the bearings lined with babbit metal well hammered, bored, and scraped to a true bearing. The frames and bed plates are of heavy design to avoid springing or vibration under any condition of load, and the sub-base is extended to carry the generator and outboard bearing. The pistons are made as light as possible consistent with proper strength and are provided with ring packing. Oiling is accomplished automatically under pressure by means of a special system. In addition to this, the main bearings and the outboard bearing are provided with oil reservoirs and rings which will lubricate the shaft independently of the automatic system.

Generators

The generators are each 100 kw. capacity and operate the lights at 115 volts and the motors at 230 volts. They are of the 3-wire type, made by the General Electric Company, and the brush holders are mounted so as to allow of simultaneous adjustment by means of a hand wheel and gear.

The specifications require that the machines must be capable of operating at full load continuously without undue heating and of running for 2 hr. after reaching normal full-load temperatures at 25 per cent overload without increasing in temperature more than the following amounts: Field and armature, 90 deg. F.; commutator and collecting rings, 99 deg. F.; rise in temperature to be above room temperature, assumed at 77 deg. F., with suitable corrections made for any departure from this temperature.

Each machine is provided with a field rheostat mounted on back of the switchboard, with a handwheel rod projecting through to the front. The generators are automatically overcompounded for a rise of voltage of 3 per cent from no load to full load, and the shunt field has sufficient capacity to deliver 25 per cent overload with a voltage not exceeding 5 per cent higher than the normal no load voltage.

The specifications require a high potential test of 1500 volts, alternating potential between windings and connections and frame, also that the lead of brushes must be practically constant from no load to 25 per cent overload, and commutation must be practically sparkless at all loads between no load and 25 per cent overload.

Auxiliary Equipment

Feed-water heating is done by a 400-hp. National heater with internal brass coil. The heater has a single 8-in. steam connection and is air vented by means of 3 automatic air valves connected in the side of the shell.

It rests upon iron saddles supported upon a brick pier and 2 pipe columns as shown in Fig. 2A.

The return from the heating system and all drips from the live steam piping are trapped to a Utility combined exhaust muffler, oil separator, pump governor, and return tank, 40 by 84 in. in size with 10-in. steam connections. The tank is connected with the boiler feed pumps which are operated automatically by means of the special governor which is connected with the tank.

Pumps

Two Blake pumps are employed, each being 7.5 by 4.5 by 6 in. in size, of the duplex piston pattern, with brass fittings throughout and adapted to the handling of hot water.

All pipe connections are so arranged that the pumps may be operated together or separately, either by hand or automatically. The main discharge pipe is provided with a relief valve and special hot water thermometer. The sump well is drained by means of a 4.5 by 3.75 by 4-in. light service duplex pump, which is arranged to draw water from the sump and discharge it into the drain from the blowoff tank.

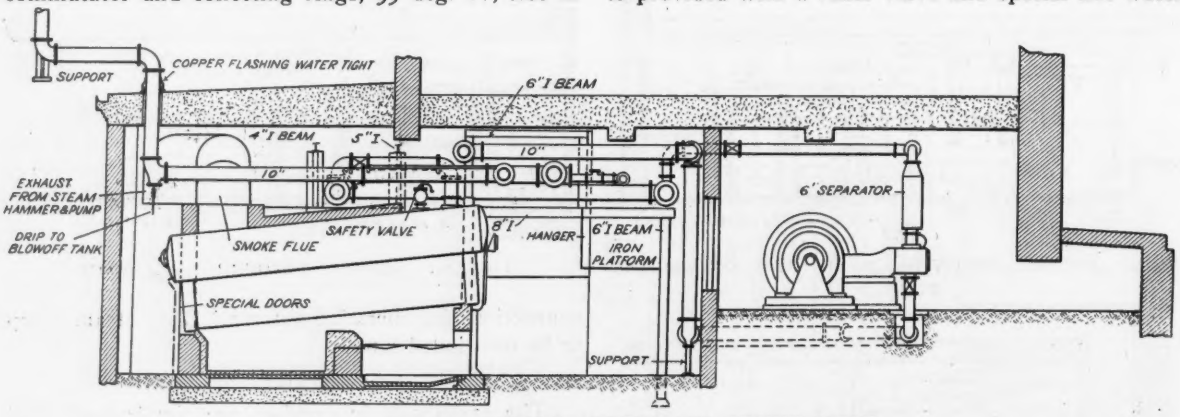


FIG. 4. SECTION THROUGH BOILER AND ENGINE ROOMS

High Pressure Steam Piping

All high-presure piping up to and including 2.5 in. is standard weight, and all larger sizes extra heavy.

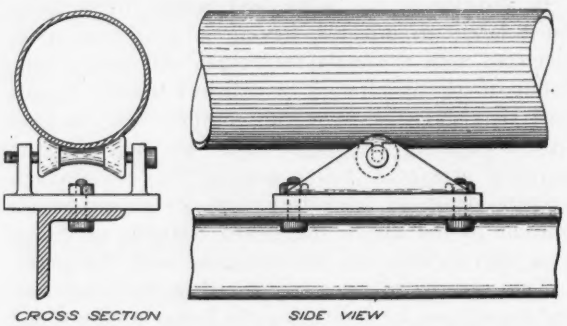


FIG. 5. SADDLE SUPPORT FOR LARGE HORIZONTAL PIPE LINES

Fittings up to and including 3.5 in. are extra heavy screwed, and all larger sizes extra heavy flanged; elbows 4-in. and larger are of the extra long turn pattern. The general arrangement is shown in Figs. 1 and 4 and is so planned that each boiler and engine can be run either separately or any number may be operated together. As already stated, all heavy pip-

ing in the boiler and engine rooms is supported from the floor to prevent vibration. Pipe columns, brick piers, and I beams are used for this purpose and arranged as shown in Figs. 1, 4 and 5. The pipes rest on special chairs and expansion rolls and are anchored as found necessary to throw the expansion in the right direction.

Exhaust Piping

All exhaust piping inside the back-pressure valve is standard weight, and fittings 6-in. and larger are flanged.

The 10-in. outboard exhaust riser is of No. 14 extra heavy gage, double-galvanized iron, spiral riveted, with flange joints.

It is supported at the bottom on a heavy iron bracket and iron braces attached to the wall of the building are provided at each joint. The top of this pipe is furnished with an exhaust head of 18-oz. copper which is drained by means of the vapor pipe back to the blow-off tank.

Feed-Piping

All cold-water piping, and all feed connections between the pumps and boilers are of brass. Connections with water columns and drips from them, and all connections for steam gages and damper regulator are of the same material.

Valves

All gate valves were made by the Crane Co. and are provided with bronze seats and gate rings. Valves less than 2.5 in. in size have composition bodies, while those of larger size are of cast iron.

Live steam for the heating system is passed through an Eclipse 6-in. reducing valve, reducing from 100 lb. to 2 lb. as a minimum. A full sized by-pass is provided with all necessary valves and fittings. The 10-in. back pressure valve in the main outboard exhaust pipe is of the weighted type, made by Atwood & Morrill and is designed with special reference to quietness of action.

Covering

The smoke connections, hot water boiler, and receiving tank are covered with air cell blocks 1 in. in thickness, wired in place. Over this is 1 in. of plastic asbestos put on in 4 coats.

In addition to this the receiving tank is covered with 8-oz. duck. Back-pressure valves, reducing valve, and all stop valves 2.5 in. and larger, and the bodies of flange fittings are covered with 1 in. of plastic asbestos and 8-oz. duck. Flanges in the engine and boiler rooms are covered with asbestos moulded covering, canvassed and made in halves, so as to be removable in case of repairs. All high-pressure piping in engine and boiler rooms is covered with 85 per cent magnesia sectional covering made by Keasby & Matteson, 1.5 in. in thickness.

The consulting engineers for the work were Hollis French and Allen Hubbard, of Boston.

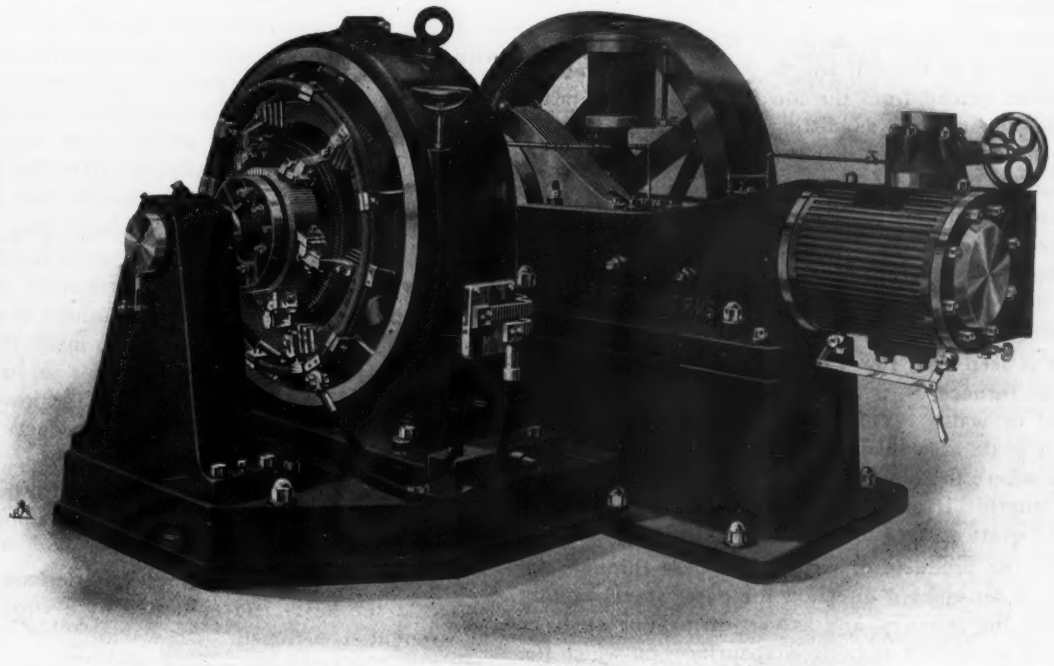


FIG. 6. AMES DIRECT CONNECTED ENGINE UNIT

IN PLANTS WHERE calcium chloride is used in place of the brine made from common salt, the solution should have a density of about 23 deg. Beaumé and a freezing point about 9 deg. below zero. Three to 5 lb. are dissolved in a gallon of water.

THE MANNING BOILER

By P. E. Merriam

IN Fig. 1 is shown a longitudinal and sectional view of a type of vertical boiler that often gives satisfactory results in practice, especially under conditions that demand a definite power to be obtained from limited floor area.

Construction

This boiler is named after Chas. W. Manning, who introduced certain improvements in the construction of vertical boilers to adapt them better for larger units than usually built, giving increased durability, safety and efficiency.

From an inspection of Fig. 1 it will be seen that the boiler is of the full length of tube type, that is, the tubes extend from the lower tube sheet or head to the upper head, as distinguished from the submerged tube type, and that it is internally fired.

Some 4 or 5 ft. of the upper ends of the tubes are surrounded entirely by steam. This allows the last few feet of tube surface to act as superheating surface raising the temperature of the steam some 40 to 60 deg. above the temperature of the steam due to the pressure at which it was generated.

It is seen from Fig. 1 that the diameter of the firebox or furnace, B, is larger than the diameter of the barrel or waist, A, of the boiler. This allows of a larger grate area than would be possible in constructions where the boiler is of the same diameter its entire length. It also allows of a better proportioning of the grate surface to the heating surface.

As the products of combustion pass through the tubes in an upward direction the gases travel rapidly toward the chimney, and as vertical heating surfaces are not so efficient as horizontal surfaces on which the gases impinge at right angles, or nearly so, the tubes used in these boilers are of comparative small diameter and of considerable length to obtain reasonable results.

No manhole is provided for access to the interior of the shell, hence several more tubes can be used than in the return tubular of the same diameter of shell and tubes. The tubes are best arranged in straight rows both ways from the handholes as in Fig. 2. This allows the crownsheet, F, to be thoroughly cleaned.

One of the greatest enemies of boilers is unequal expansion and contraction, and as a structure of the length in which these boilers are built will have considerable movement, special constructional features have been employed to reduce the wear and tear to a minimum.

Uniting the outer sheet, H, of the waterleg, B, with the waist, A, is a sheet or ring, C, of peculiar shape.

This is in reality a reverse flange and is so called, although it is known as the ogee. This sheet is made by a spinning process, and, due to its shape, provides the necessary flexibility for expansion between the furnace and upper head, and thus permits of a breathing or accordion-like action.

Under some conditions of service and material the ogee has been cracked, due to the continued bending action, and has been rapidly reduced in thickness, and consequently weakened.

Handholes

There are 4 locations that should be provided with handholes, the number depending on the size of the boiler. Handholds should be provided as shown at W, in Fig. 1, around the circumference, to give easy access to the crownsheet; another row around the bottom of the waterleg, a handhole over the firedoor and another to give access to the fusible plug as at T.

The proper location for the fusible plug, which many state laws and insurance companies require each boiler to have, is in one of the outer rows of tubes, which is of thicker material than the others, to give the necessary material for the pipe tap to insert the plug; and the plug should be located about 1 in. below the bottom of the water-glass, as this is the lowest surface that ought to be exposed to the products of combustion.

It was formerly the practice to locate the fusible plug in the crownsheet, but long before the plug let go or fused the tubes would be ruined.

The 2 sheets forming the waterleg are usually closed at the lower end or united by a wrought-iron or wrought-steel rim, E.

Joints

The character of the joints in the shell and waterleg is an important factor in determining the safe pressure to be carried. The longitudinal joints are of the triple or quadruple riveted double butt strap type, where high pressures are carried, and generally for any pressure since war is raging against the lap joint in all sections of the country. The longitudinal seam in the inner sheet of the waterleg is a single riveted lap joint and is designed for tightness rather than strength since staybolts are placed close along it.

If a double butt strap joint were used, the chances for burning the plate and rivets and the added rigidity of the structure would lead to a rapid injury to the joint. The joint in the outside sheet, H, of the waterleg is, in the latest practice a butt strap joint with a row of staybolts passing through its center.

The fire door frame is secured to the outer sheet of the waterleg, H, and the inside and outer sheets are flanged or united with a ring as in Fig. 3.

Connections

The steam gage is generally tapped into the sheet as seen at B', Fig. 1, and is for convenience in ascertaining the pressure. A better way to connect the gage is to run its siphon up and join it into the steam connections to the water column. This makes the connection in the steam space with no possibility of its becoming choked up with scale as when connected lower down and into the water space.

The blowoff pipe is secured to a reinforcing piece

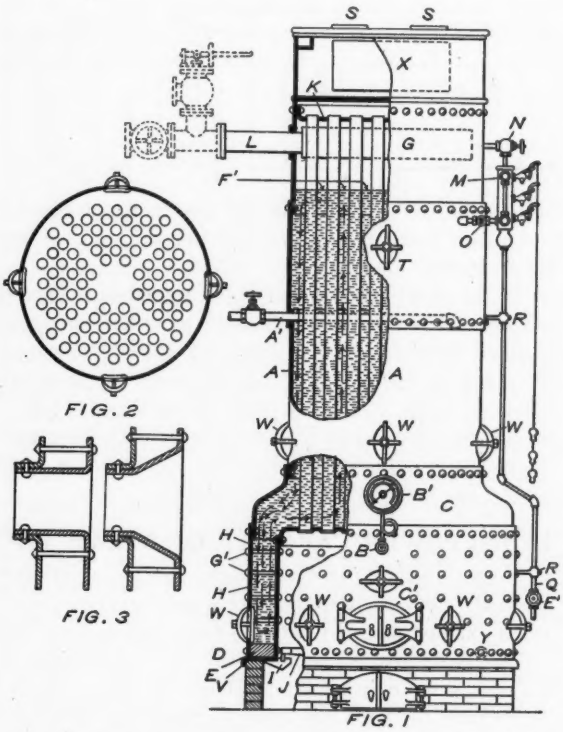


FIG. 2.

FIG. 3.

FIG. 1.

FIG. 1. SECTIONAL AND EXTERNAL VIEW OF MANNING BOILER

FIG. 2. ARRANGEMENT OF TUBES

FIG. 3. METHOD OF FLANGING AROUND FIRE DOOR

riveted to the outer sheet as near the ring, E, at the bottom of the waterleg as possible.

The location of the water column so high makes the water level difficult to be seen from the floor, making it necessary in some cases to ascend to a platform placed on a level with the columns. The valves to blow out the water column and gage glass, also the valves to shut off the gage glass, where that breaks, also the rods reaching from the gage-cocks, can be arranged to be controlled from the floor, as in Fig. 1.

The feed pipe enters through a suitable brass bushing in the shell, crosses over to within 6 or 8 in. from the other side of the boiler.

Circulation of the water within the boiler is as shown. The cooler water passes downward along the outer rows of tubes and along the shell returning upward along the inner sheet, across the crownsheet, and up among the inner tubes.

A single nozzle is generally fitted to the shell as shown in the cut, Fig. 1, on the side of the shell. To this a tee is secured, on one end of which the main stop valve is placed, and on the other end of the tee a safety valve is secured. In some cases the nozzle is secured to the top tube sheet, but this is looked upon as questionable practice since the cutting of such a large hole weakens the head which is already perforated with tube holes. Both the upper tube head and crownsheet are so located that their flanges lock outward, which makes it possible to calk them when necessary.

Setting

These boilers are usually set on a brick ring which is built sufficiently high to allow the fires to be worked to advantage from the floor. The frame of the ashpit door, is secured to the brickwork and the top of the brickwork is covered with a circular iron cap on which the waterleg rests and is not anchored to the foundation. The grate bearing bar, I, is secured as shown. The shell and waterleg are covered with a magnesia or asbestos lagging to reduce the radiation to a minimum.

Operation and Care

Frequently the water level will be seen to move up and down in the gage glass although the boiler is not foaming. This is because the liberating surface is small, being confined to the area of boiler cross section minus the area of all the tubes. The rapidly rising storm of bubbles cause a considerable commotion on the surface of the water when they escape from the water, assisted by the rising and falling, due to circulation.

When it is necessary to blow or scrape the tubes, one must ascend to the top of the boiler and open the tube doors, S S, and while standing on the small area of the tube sheet or upper head, K, blow or scrape the tubes from the upper end. The deposits fall into the firebox, from which they must be removed after each cleaning.

When the boiler is to be washed out, the pressure being all out, the gage cocks are opened and all the handhole plates removed. The loose deposits are removed, then the hose is introduced and the whole interior thoroughly washed, the crownsheet scraped and the deposits removed from the handholes around the bottom of the waterleg. The handhole opposite the fusible plug is to be opened and the surface of the plug cleaned.

Some builders provide a chain, which lies loose along the bottom of the waterleg and can be used to advantage to remove or at least loosen up the deposits in the waterleg by working this chain back and forth.

It is good practice to paint the upper tube ends and tube head, say every 3 months, with red lead and linseed oil, which will protect the metal from corrosive action. Near the top is an oblong iron plate or cup which some builders support between the outer row of tubes and shell to act as a sort of baffle plate to pre-

vent entrainment from entering the steam pipe since the steam nozzle is between the shell and the iron rings, the water having a tendency to adhere to the ring on which it first impinges and drains back into the body of water.

Calculations

The total number of square feet of heating surface is made up of the inner circumference of waterleg or firebox, area of the crown sheet less the cross-section area of all the tubes and the total outside surfaces of the tubes.

One way of expressing the rule to give this result is: Multiply the circumference of the firebox in inches by its height in inches from the grate. Multiply the number of tubes by the length of each tube in inches and by its circumference. From the area of the crown sheet subtract the cross-sectional area of all the tubes. Add this remainder to the products previously found and divide by 144 to obtain the number of square feet.

To illustrate the working of this rule let us apply it to a boiler of the following dimensions: Rated horsepower, 190; diameter of outside of tubes, 2.5 in.; length, 15 ft.; 284 in number. Diameter of shell, 74 in.; diameter of the outside of the firebox, 94 in.; inside diameter of firebox, 84 in.; and height of furnace from the grate to the crown sheet, 48 in.

The number of square inches in the inside sheet of the firebox is found to be as follows: 3.1416×84 in., the inside diameter of the firebox, $= 263.89$; $\times 48$ in., the height of the firebox, $= 12{,}666.93$ sq. in.

The area of the crown sheet is $84 \times 84 \times 0.7854 = 5541.78$ sq. in., from which we must subtract the area of the tubes. The area of a 2.5-in. tube is $0.7854 \times 2.5^2 = 4.91$ sq. in. and for 284 tubes $= 4.91 \times 284 = 1394.44$ sq. in. Subtracting this from 5541.78 gives 4147.34 sq. in. as the heating surface of the crown sheet. For a 2.5-in. tube the circumference is $2.5 \times 3.1416 = 7.854$ in.; and for 15 ft. long $= 12 \times 15 = 180$ in. $7.854 \times 180 = 1393.72$ sq. in. per tube or for 284 tubes $= 1393.72 \times 284 = 395{,}816.48$ sq. in.

We now add the number of square inches in the furnace and crown sheet to that of the tubes and obtain $395{,}816.48 + 4147.34 + 12{,}666.93 = 412{,}630.75$ sq. in. $412{,}630.75 \div 144 = 2865.49$ sq. ft. As the horsepower of vertical boilers is based on 14 sq. ft. of heating surface per horsepower, $2865.49 \div 14 = 204.68$ hp. for the boiler in question.

Since the tubes support the heads the only bracing required is to take care of the water leg. The staybolts are usually arranged in squares or oblongs in which the length is slightly greater than the diameter. Since the staybolts have a thread cut on them one must be careful to take the diameter of the staybolt at the bottom of the thread. Usually 12 threads an inch are used. The accompanying table shows the diameter at bottom of the thread for the several outside diameter of staybolts from 0.75 to 1⅛ in. with the safe loads in pounds when taking a maximum strain of 6,500 and 7,000 lb. per square inch of cross-sectional area at the bottom of the threads.

The diameter at the bottom of the thread for staybolts with 12 threads per inch becomes D (P × 1.732) = d where D = diameter over the threads; P = pitch of thread = 1-12 in. = 0.08333; 1.732 = a constant; d = diameter at bottom of thread.

To find the required pitch of the staybolts: Multiply the smallest cross-sectional area by the allowable strain per square inch and divide the product by the steam pressure and extract the square root from the quotient.

ALLOWABLE LOAD ON STAY BOLTS

OUTSIDE DIAM. OF STAY BOLTS IN INCHES	DIAM. AT BOTTOM OF THREADS	LOAD ALLOWED	
		AT 6500 LB. PER SQ. IN.	AT 7000 LB. PER SQ. IN.
0.75	0.6057	1872	2016
0.8125	0.6682	2282	2457
0.8750	0.7307	2724	2933
0.9375	0.7932	3211	3458
1.	0.9182	3738	4025
1.0625	0.9807	4303	4634
1.125	1.0432	5558	5285

If the staybolts used are 1⅛ in. outside diameter, the area at bottom of the thread from the above rule or table is 0.775 sq. in. Applying the above rule we have, taking 6500 lb. as a safe strain on a square inch, $6500 \times 0.775 = 4907.5$, the allowable load; if the steam pressure is 100 lb. a square inch we have $4907.5 \div 100 = 49.075$, the square root of which is practically 7 in., the pitch of the staybolts.

HORSEPOWER CAPACITY OF STEAM PIPES

As an average for steam engine design, a velocity of 6,000 ft. a minute in a steam pipe and 8,000 ft. a minute in an exhaust pipe is used, and this gives about 0.14 sq. in. internal area per horsepower for steam pipes, and 0.2 sq. in. for exhaust pipe. Based on these values, the accompanying table has been worked out showing the engine horsepower that can be taken care of by different sizes of pipe when used for exhaust and for live steam:

ENGINE HORSEPOWER CAPACITY

Size Pipe Inches.	For Exhaust.	For Steam.
½	1.52	2.18
¾	2.66	3.81
1	4.31	6.16
1½	10.18	14.55
2	16.78	23.95
2½	23.95	34.15
3	36.95	52.30
3½	49.45	70.50
4	63.65	91.00
4½	79.70	114.00
5	100.00	142.70
6	144.60	206.50
7	193.80	276.80
8	250.00	357.50

DURING THE YEAR 1908 the Pennsylvania Special, the 18-hour train running between New York and Chicago—a distance of 912 miles—arrived at Chicago on time 315 out of 366 days, and at New York on time 314 days in the year.

FAULTS IN ENGINE DESIGN

By George P. Pearce

I RECENTLY saw an item about a cast-iron crankpin which broke near the web while in operation. The pin was 3.5 in. in diameter by 4 in. long, cast solid with the web. The engine cylinder was 12 in. in diameter, the initial pressure 135 lb. a sq. in. and the speed 300 r. p. m., so that a load of $12\times12\times0.7854\times135=15{,}268$ lb. was placed upon the unfortunate pin 600 times a minute. I thought it would be interesting to see what load this pin would safely carry and also what dimensions this pin should have had in order to conform with modern engineering practice.

The safe moment of resistance, or load, that the pin will safely sustain is 0.0982 times the cube of the diameter of the pin, times the same strength in pounds to a square inch, of cast iron to resist flexure, which in this case becomes $0.0982\times43\times2{,}400=10{,}102$ inch-pounds.

The load or bending action put on this pin while the piston is moving under the full pressure of 135 lbs. a square inch is equal to 0.5 times the total pressure, times the length of the pin, or $0.5\times15{,}268\times4=30{,}536$ inch-pounds. Thus a load of 30,536 inch-pounds was placed upon a pin capable of safely sustaining only 10,102 inch-pounds and the pin eventually broke.

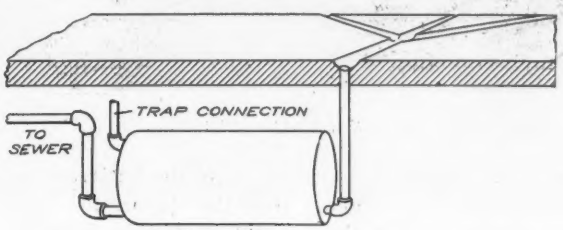
This is not the worst feature of the design, however, for the pin must also be designed to give a suitable bearing surface and the greatest load that should be applied to a pin of this description and speed would be about 300 lb. a square inch of projected area. The projected area is the diameter times the length. The area of this pin bearing is $3.5\times4=14$ sq. in. and $14\times300=4{,}200$ lb., the safe load for a smooth satisfactory running, whereas the pin was called upon to work smoothly with a 15,268 lb. load or $15{,}268\div14=1{,}090$ lb. a square inch.

Let us now figure a cast-iron pin that would be somewhere within good running requirements. I do not wish to advise, however, the use of cast-iron crankpins for 200-hp. engines at 300 r. p. m. Cast iron never was suitable for bending stresses and transverse shocks. As this crankpin would have to work at times under a load of 15,268 lb. and as the safe bearing pressure is to be 300 lb. a square inch, then it must have a bearing area of $15{,}268\div300=51$ sq. in. To avoid making the connecting rod too ungainly and top heavy and also to avoid too much overhang, it would be wise to make the pin not more than 6.5 in. long, the diameter will therefore be $51\div6.5=7.86$ in. and to get an even dimension, we will call it 8 in. diameter. Now we have our crankpin 8 by 6.5 in. and we encounter another difficulty, for it is very unsatisfactory to cast a great chunk of iron near the edge of the crank disk on account of the tremendous strains developed while the casting is being cooled. If we could get the pin to cool from the inside outward, the shrinkage strains would be reduced to a minimum and this can be done by setting a cope in the center of the pin, thus giving the middle part an opportunity to cool first.

We must, however, take care that after coring and boring we leave the pin amply strong to withstand the working load. We know that the pin as designed for a bearing pressure of 300 lb. a square inch is strong enough to carry the load; let us see how it would be if we put in a 3.75 in. core, which would bore to 4 in., thus we would have a crank pin with a 4 in. hole through it. The safe moment of resistance of a hollow pin is the product of a constant times the difference of the fourth powers of the outside and inside diameters, times the safe stress on a square inch of iron, divided by the outside diameter; this in the case under consideration is: $0.0982\times(8^4-4^4)\times2{,}400\div8=113{,}097$, and the bending action on the pin is $0.5\times15{,}268\times6.5=49{,}623$ inch-pounds. This pin would probably give as much satisfaction as could be had from one of cast iron, but there would always be the danger of a crack starting which would be almost certain to spread until one day the pin would break off and the economy in the first cost would be small compared to the repair bill likely to come in.

SAVING OIL IN CONDENSER DRIPS

A NOVEL device for the saving of oil is in use in the power station of the Metropolitan West Side Railway in Chicago and was designed and installed by J. C. Lovett, chief engineer. The basement of this plant is a concrete floor having grooves by which the drips from the various pumps are led to a central drain. The drip flowing in these grooves carries a thin film of oil on the surface and to save this a separator made of an old tank once used for carrying Pintsch gas in the elevated trains has been utilized. This tank, which is 20 in. in diameter and has a capacity of 150 gal., is placed below the basement floor giving a head of about 3 ft. from the floor drain into the tank. The drainage is carried from a pocket in the floor to the bottom of the tank at one end and at the opposite end, connected to the bottom, is a pipe which goes up almost to the floor level. Passage of the water and oil through this tank is usually so slow that the oil separates out and rises to the top from which it is carried off by a trap. Four or 5 gal. of oil a day are saved by this device and put back into the engine oiling and cleaning system.



DEVICE FOR SAVING OIL

GAS ENGINES AND PRODUCERS

POWER HOUSE AND BRIDGE MOTIVE POWER

CLINTON DRAW SPAN FOR C. & N. W. RY., CLINTON, IOWA

A DEPARTURE from ordinary practice may be noted in this installation in that the prime mover is not mounted on the bridge but is located on the adjacent west shore. The reasons for so doing in this case are obvious; first the size of engines and their accessories, and second the vibration which is almost impossible to eradicate on high-speed gas engines mounted on bridge structures. Another feature which determined the land location of the power plant was the installation of a large storage battery.

Motive Power

At a distance of 400 ft. from the center pier is located a substantial building built of local sand lime brick, stone trim and corrugated asbestos roofing, for the housing of the power equipment and batteries.

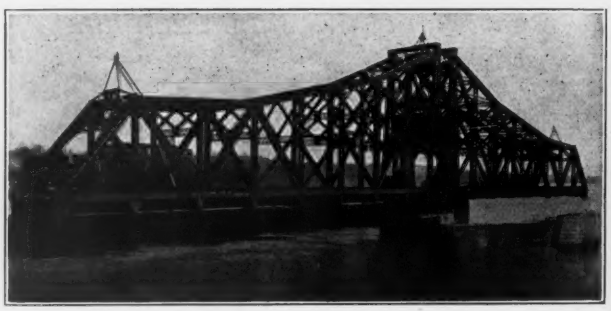


FIG. 1. CLINTON, IOWA, SWING BRIDGE, C. & N. W. RY.

As the bridge is to be swung from the batteries and only in case of emergency from the engines the latter are smaller in size than would usually be installed, they being used in normal operation only to charge the battery.

These prime movers consist of 2 twin cylinder vertical 50-hp. Otto gasoline engines operating at a speed of 360 r. p. m., directly connected to 300-volt, Western Electric, 30-kw., direct-current generators. Gasoline storage capacity of 300 gal. in steel tank is provided for outside of the building accessible for filling from service tank cars. Through electrical combinations on the switchboard, the following sources of power are obtainable, which reduces the liability of shut down to a minimum: From storage battery; from both engines operating in parallel; from either engine separately; from either engine and battery in parallel.

As the power thus generated may be used for other purposes than swinging the draw, it is proposed to meter the current consumption on each feeder that leaves the switchboard. Accurate records at all times are thus available.

Battery

Separated from the engine room with a solid brick partition is the battery room, containing 120 cells arranged in 2 tiers and having a total capacity of 640 ampere hours. The cycle of operating from the releasing of the motor controller levers to full open draw is 1.5 min. or 15 seconds for lowering ends of bridges and 1.25 min. for swing. With the battery as specified above it will be possible to obtain about 16 swings inside this limit and 8 swings at a somewhat reduced speed, making a total of 24 complete swings. Provisions are also made to operate signals and de-

FIG. 2. CLINTON BRIDGE AND POWER HOUSE

rails from the storage battery, and also government and channel lights.

Bridge Connections

Connecting the power house switchboard and the distributing board in the operator's house on the draw is a substantial submarine cable sunk in the bed of the river. The draw swinging only 90 deg. either way and back, no pivot switch is used, the connection being made through flexible cable. On the distributing board are mounted the indicating and protecting instruments for the bridge motors. Two series-wound 50-hp. motors operating in parallel are used for swinging and a 20-hp. motor for each end lift; the former are located in the operator's house with change gears for reducing speed one-half.

With the slow speed gearing and 1 motor the bridge may be swung with only 1 engine. For centering and locking the span air operated plungers at either end are used, which are controlled by a 4-way

valve interlocked with the motor controllers. This mechanical interlocking feature prevents any operation out of sequence for proper opening or closing of the span. The air supply is furnished by a 10-hp. direct connected air compressor of the railway type, and a storage capacity of 150 cu. ft. at 90 lb. pressure will always give ample power for centering, braking motors when coasting to final position and blowing whistle for signals.

The end lift motors are controlled with automatic switches located at the ends of the draw, which stop the motors independent of operator at either end of

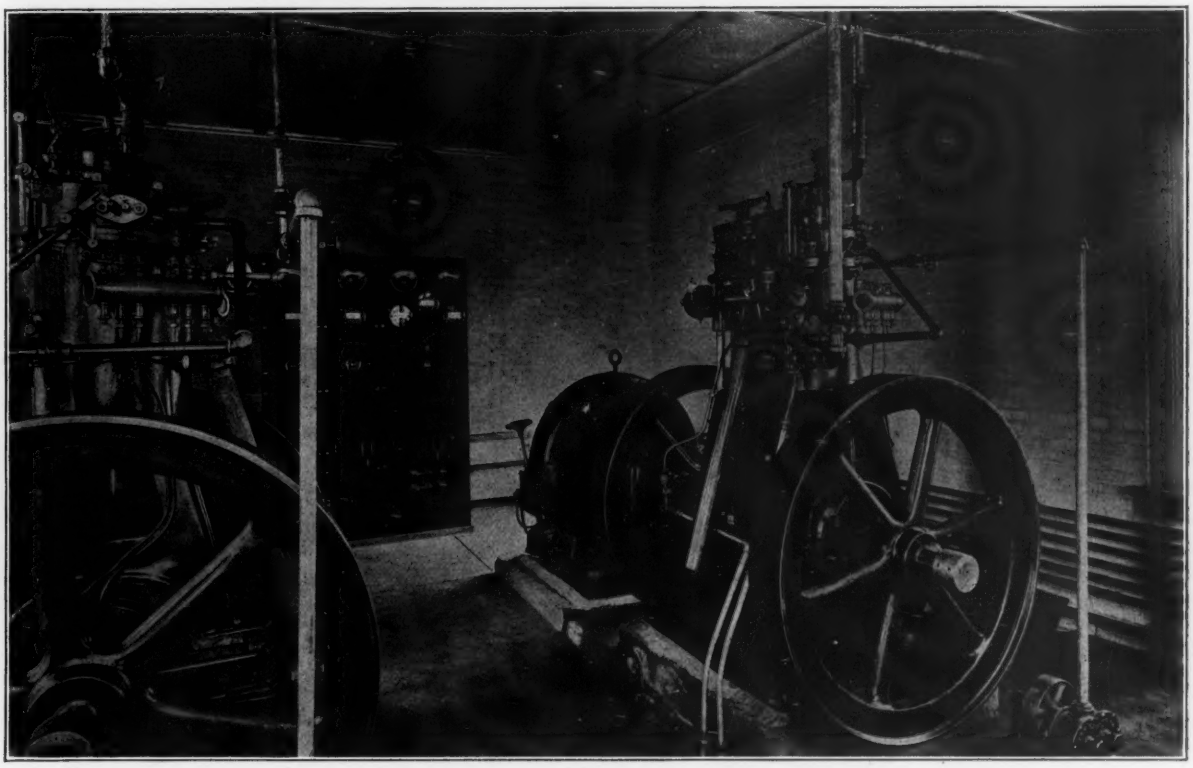


FIG. 3. INTERIOR OF POWER HOUSE. CLINTON BRIDGE

travel by opening the circuit on the distributing board.

Indicating lights on the switchboard show the operator when the plungers are in or out, when the ends of the bridge are raised or lowered and when the bridge is full opened or nearly closed. Red lights burn when ends are lowered and green when track is clear. All bridge lighting, pier and government lights are controlled from the distributing board in the operator's house at the same voltage as the batteries.

IT HAS BEEN DISCOVERED that in creosoting wood to preserve it, bark, even a thin layer of the inner bark, which is left on the wood prevents the creosote from penetrating the pores and, therefore, leaves the grain liable to decay. This point should be carefully watched when getting piling or poles for foundation or line construction.

POINTS ON GAS ENGINE PRACTICE

AT the meeting of the National Gas and Gasoline Engine Trades Association at South Bend, June 22-24, the discussions on the various papers were active and informing. The attendance was large and the future outlook for the association is of the greatest promise. Some of the papers presented are given in abstract in this issue, others will be presented later, as space permits.

In the discussion of a paper by H. E. King, on the test of a gas engine driven by natural gas, it was found that the engine, which was a Nash 3-cylinder vertical with cranks set at 120 deg., bore 8.5 in., stroke 11 in., revolutions 275, and rated horsepower 50, took 188 cu. ft. of gas per hour when running light, and 40 cu. ft. of gas extra to drive the belt and generator, so that 228 cu. ft. were used in overcoming the friction of the generating outfit. The gas was 800 to 900 B. t. u. per cubic foot.

It was found that after the friction was overcome it took almost exactly 7 cu. ft. of gas per brake horsepower, regardless of the load on the engine, the added fuel being always in proportion to the added load.

A paper by H. W. Jones discussed the use of a regulating device controlled by a thermostat to keep the outgoing water from the cylinder jacket always at the same temperature. He showed not only a saving in the water bill but a saving in the fuel required when using this method. In discussion on this topic it was

brought out that the method is not a new one but that it is an important one. The control system is operated by compressed air at 15 lb., a pilot valve in this compressed air pipe being operated by the thermostat.

It is important that the temperature should be kept right for the sake of the cylinder lubrication. If too hot the oil will be carbonized and will clog the valves; if too cold the friction will be increased. Mr. Harris, an oil expert, gave as his opinion that from 650 to 700 deg. F. is about the right temperature.

In the discussion of Mr. Atkinson's paper on Gas Producers, it was brought out that a producer will carry 50 per cent overload for from 2 to 3 hr., that a producer plant should be carefully designed to go with the engine, and the proportions be right; that 1 cent per kilowatt-hour on a 100-hp. plant is a reasonable amount for the fuel, attendance and depreciation, and that the smallest size of producer which can be run economically is a 20-hp.

An instance was given of a producer gas plant at Port Washington, Wis., where 2 2,000-hp. engines are run 20 hr. a day at a fuel expense of $1,800, and these engines were run at one time for 6 weeks without any holder, the engine inlet being attached directly to the producer.

The velocity of gas through the valves in a producer system to give best results should be about 80 ft. per second, which gives the diameter for the pipes and valve openings of 0.45 the cylinder diameter for both inlet and outlet pipe systems.

An interesting point brought out by Mr. Smith in his paper was that in a gasoline engine back-firing will occur when the mixture is too lean, while with a producer back-firing will occur when the mixture is too fat or too rich, on account of the lingering flame in the small openings off the cylinder.

To prevent this back-firing it is necessary that all valves should close flush to the internal surface of the cylinder unless the openings are very small, say less than 0.5 in diameter. Thus, unplugged openings for indicators and air cocks are liable to be a serious cause of back-firing in producer gas engines, because the slow rate of combustion in producer gas will leave some burning gas in these openings at the time when the new charge enters the cylinder. Mr. Smith also called attention to the fact that the propagation of flame through hydrogen is 9 times as rapid as through the ordinary producer gas, which is mostly carbon monoxide.

This can be taken care of, however, provided the hydrogen in the gas is constant, but if there is variation in the amount of hydrogen in the gas it makes trouble in the setting of the ignition and is liable to cause back-firing and other difficulties.

FOR LARGE GAS ENGINES concrete foundations should not be less than 3.5 ft. deep, and the top raised at least 6 in. above the floor, extending beyond the base of the engine 2 in. all around.

THE SUCTION GAS PRODUCER FOR SMALL POWER PLANTS*

BY C. J. ATKINSON

GAS producers can be divided into 2 classes, namely, pressure and suction. The difference between them being that those of the pressure type work above atmospheric pressure, while those of the suction type work slightly below atmospheric pressure.

If we have a cylindrical casing lined with fire brick having at its lower extremity a fuel-supporting grate enclosed by an ash pit with a passage for the admission of air, etc., while at the top of the cylindrical shell we have a gas outlet and a means for admitting fresh fuel without allowing either gas or air to pass, with such a machine we can make a number of experiments.

If we have a shallow fire in our producer and an abundant supply of air, the carbon will be completely consumed. The products of combustion being CO_2, and a large quantity of heat will be developed; for instance, one pound of carbon completely consumed would give us 14,640 B. t. u. But, if there was a considerable depth of fire in the producer, as there should be in practice, the resulting gas would be CO instead of CO_2, for when there is an excess of highly heated carbon the CO_2 formed in the lower part of the fire is reduced to CO with an absorbtion of heat.

Therefore we see that it is absolutely necessary that there should be a deep fire so that these 2 reactions can take place. It is not absolutely decided that these 2 reactions are what goes on inside the gas producer, but the result is the same. We get carbon monoxide formed plus a certain amount of heat liberated and the gas would have the following composition, taking into consideration the nitrogen of the air, carbon monoxide 34.7, nitrogen 65.3 per cent. Now, if the producer was so constructed that no heat could leave the fuel column, the temperature would increase to such an extent as to be impracticable, but some heat will escape through the brick lining or will be carried away as sensible heat in the gas formed. This is therefore a loss, and to avoid this loss as far as possible it is best to keep the temperature of the fire within due bound.

This we are able to do by mixing a certain proportion of steam with the in-going air, which steam will be decomposed and so absorb some of the heat which would otherwise be carried away. The reaction of steam upon heated carbon may be as follows, providing the fire is of sufficient temperature:

Water + carbon gives hydrogen + carbon monoxide and absorbtion of 4320 B. t. u. per pound.

If the temperature of the fire is too low, another reaction will take place.

Water + carbon gives hydrogen + carbon dioxide and absorbtion of 2820 B. t. u. per pound.

It will be observed that in both cases there is a

*Read before National Gas and Gasoline Engine Trades Association.

large absorption of heat, and it is at once apparent why a very small quantity of steam reduces the working temperature. The effect of the presence of steam in the air blast is that a smaller proportion of the total heat of combustion is liberated in the form of sensible heat in the producer, but a corresponding larger proportion is available when the producer gas is used.

It should be understood that from the point of view of heat quantities the use of steam in the gas producer is simply a means of absorbing the sensible heat developed by the partial combustion of carbon and storing it for future use. There can be no actual increase in the total quantity of heat which can be obtained from a given weight of fuel.

Besides avoiding excessive heat in the producer the steam has a further practical advantage, in that a gas of greater calorific power per unit volume can be obtained than when air is used alone. It has been shown that for every volume of carbon monoxide in the gas made with air alone, there must of necessity be 3¾ volumes of nitrogen, but where steam is used the gas which is formed by its decomposition is free from nitrogen, therefore the larger the quantity of steam used, the richer the gas per unit volume, but there is a limit to the quantity of steam that can be used, due to its cooling action on the fire. This quantity is not the same in all producers, as some producers are so constructed that less heat escapes through the lining or is carried away with the gas.

In designing a producer it is necessary that the velocity of the steam and air through the fuel column should not be excessive, otherwise there is no time for the reaction to be completed, and the fine ashes of the fuel will be carried upward, choking the fuel column. It is also necessary that where the load on the engine or the demand for gas is variable the amount of steam should be varied and in greater proportion than the variation of the load.

Also we have seen that by insulating the fuel column, extracting the sensible heat from the gas and returning it to the fuel column by some means or other, we can make a richer gas, as the fire will then stand a larger proportion of steam, there being less loss of heat.

Theoretically, the maximum amount of steam that an ideal producer would stand is 0.64 lb. for every pound of carbon consumed. But it is impossible to use this quantity in practice and still have the whole of it converted into hydrogen and carbon monoxide. If a larger quantity is used it will still be decomposed, but will give a certain amount of carbon dioxide, because of the lower temperature of the fire. In practice we aim to keep our fire at the maximum temperature permissible, which temperature is limited by the ash contained in the fuel used and depends upon the temperature at which this ash fuses. With most of the American coals we can make a producer in which the amount of carbon dioxide runs about 4 per cent, but to do so we have to keep as much heat in the fire as possible.

SCIENCE OF THE JUMP SPARK*

By J. A. Williams

IN the modern stationary engine, compressions have been carried to the very limit permissible with the kind of fuel used, with the end in view of getting the greatest possible fuel economy throughout all the various ranges of load. This condition of high compressions renders jump-spark ignition with the ordinary automobile or motor boat type of jump-spark coil extremely difficult and unreliable, if not practically impossible. This is the reason why so many high-compression stationary engines use make-and-break spark instead of jump-spark ignition.

Details of Spark Coil

To familiarize ourselves with the indispensable but much-abused spark coil, let us analyze it, pull it to pieces and see what it is built out of, how it is built, and why. We will begin by naming the various component parts of the spark coil and then designate their true function.

Core

The iron wire core consists of a bundle of soft iron wires and occupies the central position in a spark coil. The iron wire used should be extremely soft and possess great magnetic conductivity and the property of instantaneous and complete demagnetization.

The function of the iron wire core is to receive from the primary winding and store up in the form of magnetic energy the electrical energy that is applied to the primary winding.

Windings

The primary winding consists of a few turns of heavy, well-insulated copper wire of high conductivity. In the usual coil it consists of from 200 to 300 turns of wire.

The primary winding is to receive the battery or magneto current and circulate it around the iron wire core, so as to charge it with magnetic lines of force. Furthermore, it has an additional function in acting as the primary winding of a transformer when operating under the condenser discharge and producing a secondary spark in the secondary winding.

The secondary winding consists of a great many thousand turns of very fine silk insulated copper wire and surrounds the primary winding.

The secondary winding is purely a transformer, as it multiplies the voltage of the primary winding and at the same time reduces the amperage of the primary winding in a ratio entirely dependent upon the number of its turns, as compared to the number of turns in the primary. For instance, if there are 100 times as many turns in the secondary winding as there are turns in the primary winding, then there will be 100 times as many volts in the secondary winding as the condenser discharge delivers to the primary winding and conversely 100 times less amperage in the secondary winding than there are amperes passing

*Read before the National Gas and Gasoline Engine Trades Association.

through the primary winding, due to the condenser discharge.

Vibrator

The vibrator of a spark coil consists of a stationary electrode which is tipped with a platino-iridium point and a movable or vibratory electrode which consists of an iron wire core and is held by spring tension away from the iron wire core, keeping its own platino-iridium point in firm contact with that of the stationary member.

The function of the vibrator is purely that of a circuit breaker. It simply breaks or interrupts the primary current and stops the flow when the iron wire core has been charged sufficiently strong with magnetism to produce a satisfactory secondary spark.

Condenser

The condenser consists of a number of alternate layers of tin foil and mica, or tin foil and properly prepared paper. Certain of its sheets are positive and are connected together and lead to 1 electrode of the vibrator. An equal number of its sheets are negative and are connected together and lead to the other electrode of the vibrator, but are insulated from the positive sheets by means of mica or paper. Throughout the entire condenser there is alternately a positive sheet and a negative sheet, thus making these sheets intermesh with each other, and at the same time be thoroughly insulated from each other.

The function of the condenser is not, as commonly supposed, merely to stop the sparking at the platino-iridium points when they interrupt the current. True, it performs this function, but its true function is to receive the kick of the coil, thus storing the impulses of electricity generated in the primary winding by the rapid demagnetization of the iron wire core upon interruption of the primary current, then instantly to throw this largely increased amount of electrical energy through the primary winding.

The Coil In Action

Having thus described the various parts of the spark coil and their functions, we will now consider a spark coil in action and see how these various parts act and react upon one another.

For illustration we will assume that we have a spark coil which has 250 turns of copper wire upon its primary winding and 25,000 turns upon its secondary winding and a battery current at 6 volts. We will connect the battery to the coil and close the circuit. We will assume that when the current strength rises to 4 amperes it will generate sufficient magnetism in the iron wire core to draw the vibrator tongue down and break the primary circuit. This will give us $4 \times 250 = 1000$ ampere turns of magnetizing power applied to the iron wire core.

As the vibrator acts and the primary current becomes instantly interrupted the tendency of the iron wire core is immediately to collapse or lose its magnetism. The mere fact of this rapid demagnetization creates a powerful dynamic current of electricity in the primary winding, for it is a well-known principle that the withdrawal of magnetic lines of force or the application of magnetic lines of force through the axis of a turn or turns of wire, such as the primary winding, will create an electric current. An increase in number of lines of force will produce an increase of voltage or current in the opposite direction.

This is the principle that all dynamos or mechanical generators of current operate on. It isn't the mere fact of possessing lines of force threaded through the axis of the winding that creates a current, but it is the rate of change that produces current.

We therefore see that the rapid abstraction or accretion of lines of force will set up a powerful electromotive force or voltage within the primary winding. This electromotive force or voltage charges the condenser with a heavy current at strong voltage. The condenser in turn reacts in the opposite direction and sends a strong current through the primary winding, which in turn remagnetizes to an extent the iron wire core. It in turn rapidly demagnetizes and sends a surge of current back into the condenser, thus creating an oscillatory effect. This produces by induction several surges of current back and forth through the secondary winding.

Secondary Voltage

Now as the turns of wire in the secondary winding of this particular coil are 100 times greater than the turns of wire in the primary winding, the voltage in the secondary winding is 100 times greater than the voltage set up by the discharge of the condenser in the primary winding, and is of sufficient strength to jump a long air gap or to shoot the compression in the cylinder of a gas engine.

The voltage in the primary due to the kick of the average spark coil is in the neighborhood of 250 volts. Assuming that this coil in question produces 250 volts, then the voltage produced by the secondary winding would be 100 times as great, or 25,000 volts, for there are 100 times as many turns on the secondary winding as there is on the primary winding, consequently a multiplication of 100 to 1 in the voltage.

Condenser Action

In summing up the action of a spark coil, we are brought face to face with the enormous importance of the condenser and the large part it plays in energizing the coil and producing the spark. Without the action of a condenser it would be impossible to produce a jump spark of sufficient intensity to ignite the charge.

The spark produced by a single interruption, while it looks like one spark, if split up and analyzed, will be found to consist of several sparks; the first one will be the largest, representing the first surge of the condenser through the primary winding, and each succeeding one smaller. In other words, the oscillation dies out just as would the oscillation of a pendulum.

The greatest problem in spark-coil building is so to

proportion the condenser and windings and build the coil that there will be just as few oscillations of the condenser as possible, thus giving to each oscillation a greater amplitude, causing a larger spark, more dynamic in its character and of greater heat value. With an improperly proportioned condenser and improperly insulated windings, the condenser discharge becomes very rapid and consists of a large number of small oscillations, which produce a static spark in the secondary winding, which has no heat value and is, consequently, worthless as an ignition spark.

There is one important feature of the action of a jump spark coil which I have never seen brought out before, although it exists in every jump spark coil in automobile work, and I believe on most, if not all, stationary engines.

It is general practice to construct spark plugs with only one insulated terminal and to spark from this terminal to the frame or body of the plug, making it necessary to have the other end of the secondary winding grounded to the frame of the engine by means of its being connected to some part of the primary circuit.

When using a spark coil under these conditions the more turns of wire on the secondary and the longer the spark gap, the more highly charged becomes this condenser; the secondary end of the winding connected to the plug forms one plate of the condenser, and the primary winding, together with the engine, and all other parts which are connected to the primary, form the other plate of the condenser.

Now for jumping a small gap or shooting a rich mixture of low compression, no great electro static stress or strain is placed upon this self-constituted condenser, but when a coil of this type is used on stationary engine work, where high compressions and thin mixtures of high electrical resistance are met with, it is practically impossible to create a dynamic spark of large heat value, for the energy of the secondary current all goes into charging this unwelcome condenser, and rapid oscillations are set up which render the spark static and of no heat value.

The only way in which this harmful condenser effect can be practically eliminated is by bringing out both ends of the secondary winding and not grounding either end through the frame of the engine, the primary winding, or anything else; but each end of the secondary winding should run to its own spark plug terminal.

I would suggest for all stationary engines of high compression the use of 2 spark plugs per cylinder so located in the cylinder of the engine that circles drawn from these spark plugs as centers will touch each other, and also touch the opposite sides of the cylinder bore, thus giving each plug a position as nearly central to each half of the compression chamber as possible. This would then give a pure dynamic spark under the adverse conditions of stationary engine ignition from any spark coil of good grade and sufficient size, and would give 2 instantaneous sparks at widely separate points, which would tend to complete combustion of the charges very much quicker than a spark emanating from 1 point only. It would be killing 2 birds with 1 stone. We would be changing a static spark of low heat value into 2 dynamic sparks of great heat value, having double the sparking effect in the cylinder.

I wish to state here, and now, that it is absolutely impossible to make a jump spark coil that will shoot compressions of from 135 to 150 lb. with thin mixtures and do it with a dynamic spark where 1 end of the secondary winding is grounded. I therefore strongly recommend the use of 2 spark plugs per cylinder and the bringing out of both ends of the secondary winding of the coil to these plugs. When used in this way it is easy to construct a jump spark coil that will give a dynamic spark of intense heat and of sufficient voltage to puncture any compression and to shoot any mixture, no matter how thin or how high its electrical resistance.

You can not reasonably expect a spark coil, which is only strong enough to shoot 60 lb. compression, to shoot 160; large spark coils should be used on heavy stationary engines.

While I have not had an opportunity to test an engine with 2 spark plugs and with coil as above suggested, I would hazard a prediction that this form of jump spark ignition will be found to develop greater power than would a make and break spark, for this reason; while the spark from each plug would not necessarily be hotter or more intense than make and break spark, there would be 2 sparking points and 2 points from which to propagate the ignition, thus producing more rapid combustion.

AUTOMATIC STOKERS for firing of locomotives are not common practice, but the Chicago & Alton Railroad has started the policy of equipping its locomotives with such devices and the first installation ordered was 10 automatic stokers, which have proved so satisfactory that 26 locomotives, including fast passenger service between Chicago, St. Louis and Kansas City, have also been equipped. This leaves the fireman free to watch signals and to take charge of the throttle in case of any emergency. It also makes him more efficient in watching signals, as his eyes are not affected by the glare of the fire when feeding the furnace. The road has found that the device used will fire successfully all sizes and kinds of coal, and by the use of the inferior grades has produced a substantial saving, as well as cutting down the amount of smoke made. The requirements of a stoker on a locomotive are severe and those adopted by the Alton seem to meet these requirements in all particulars. They make it possible to fire at frequent intervals, to keep a light, bright fire, to maintain full steam pressure at all times and to give a chance for inspection of the fire whenever necessary. They have been used on the longest and heaviest runs and the fire has been found in perfect condition at the end of the run.

MAKING HER GO

By C. R. McGahey

THE steam engine was developed through many years and some of its features were almost inherited from other machines. While a steam engine running is quite a simple piece of machinery it may require an expert to put it in a condition to work most economically. Now this is true of the modern gas engine which has been gotten down to a simple form; some of them are built valveless, a type which works well when everything is in perfect order, but which becomes the more annoying when some simple condition changes.

The gas engine family has been developed in the present era of well-educated mechanics, its commercial value dating back to the Centennial of 1876 when Otto had his engine in operation there. I wish to recall one point at this time as to the durability and reliability of the gas engine. In one of the large southern cities the writer found an old "Otto" of 25 hp. that was purchased during the Centennial year and was superseded about 2 yr. since by an electric motor. The writer was told that this engine had given no trouble and was always ready to go; it used city gas and made a most remarkable record. I have mentioned this fact and condition to disprove any statement as to the gas engine being annoying; when one gives trouble it is most likely due to misuse by those in charge.

Now let's have a comparison: Should our steam engine fail to work, we at once look for a broken valve rod, loose valve or a slipped eccentric; well, these conditions are generally considered simple to remedy; they are conditions visible to the eye, and a few moments search and work will put them in at least passable condition.

Now in our gas engine, when she fails to go, conditions are somewhat changed—on the order of the electric motor; you cannot see all of the conditions, but a few fundamental facts can be laid down as follows: First, we must have gas in the cylinder. Next, the valves must close so as to have this gas compressed in the cylinder. Next, we must be able to generate a spark in the cylinder so as to cause an explosion of this compressed gas in the cylinder. Having these 3 conditions right, we can get an explosion and the engine will move. When we are able to get it to turn over we can then make more delicate adjustment provided any part has become disarranged.

Now when a small engine fails to work, the first step would be to turn it over, and in turning we find that we have compression by the engine turning hard on the compression stroke. If we have this right, the next step is to see that we have gas in the cylinder, and finding this right, we can compress this gas.

Then the next step is to see that the spark is there; when these conditions are right, as stated, we will get an explosion under nearly all conditions.

When we fail to get compression, what is wrong? If we have a tight cylinder and the valves close at the right time, we can get compression; if it fails, look for a broken valve on inlet or exhaust, or a valve that has hung up or become cut. One among the common causes of the loss of compression is the use of poor cylinder oil or a low grade of gasoline in that type of engine, causing a carbon sediment, gumming up the packing rings on the piston and allowing a free escape of the gases past the piston. In this instance we should take the piston out and wash it clean with kerosene oil so that the rings will not stick in the grooves. A condition of this kind is generally marked when the engine will run at all by the appearance of smoke at the free end of the cylinder on single-action engines.

When we have the piston tight see that the valves are tight and if they close at the right time you will have compression which easily makes itself evident by the engine resisting the turning movement. The condition of the spark or ignition device can easily be tested by disconnecting the wires and touching them together; we should get a brilliant flash, and should the spark be of a red appearance, the battery is run down and it would be useless to go further until this was corrected. If we are running dry cells, it frequently happens that one or more cells have become run down; by disconnecting all the cells and trying each one independently, the ones that will not make a brilliant spark can be replaced with new ones and the battery will be in good condition. When this is done, it would be a good idea to try the spark plug outside of the cylinder or sparking device and if we find that it is in good working condition we then know that we have compression and the spark, and next is to know that we have gas in the cylinder. When we have these conditions, we must see that the timing is right. The exhaust must close right as well as the intake valve and the sparker contact must be made at the proper time.

Sometimes when all of these conditions are normal the engine will fail. I have seen in small engines where the gasket that goes between the cylinder head and the main cylinder would allow a small leak of water into the cylinder causing the failure of the engine to work. These are some of the simple happenings around a gas engine. Sometimes we have the engine exploding too soon or back firing, which may come from the cylinder being hot. I have run across bad cases of this where the water jacket had become filled with scale and sediment from the water. By the use of some suitable boiler compound this scale can be removed, which sometimes requires several weeks.

This condition can often be detected by the bottom of the cylinder becoming very hot as this portion of a horizontal engine will fill up with scale first, and I have observed on small vertical engines the paint burning off near the bottom of the cylinder which is a sure indication of this scale forming there.

LONDON LETTER

Diesel Type Engines for Liquid Fuel

By W. A. Tookey

IT HAS been abundantly proved that, among all liquid fuel engines, those working under the Diesel principle, by the compression of pure air and injection of the combustible at still higher pressures at or about the end of the compression period, are superior in efficiency to all other types in which the vaporized oil and air are subjected to compression. But one of the disadvantages of the Diesel engine has been that the high compression pressures required, namely, about

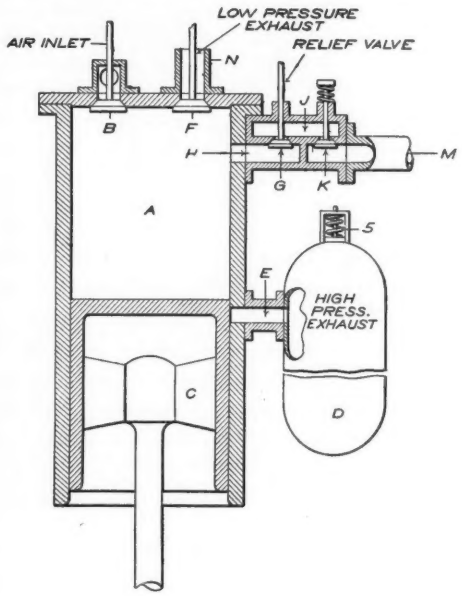


FIG. 1. ARRANGEMENT OF CYLINDER FOR PROPOSED BROWETT SYSTEM

35 atmospheres, necessitate a strongly built and costly engine, which makes the initial outlay a considerable item.

If it were practicable to obtain equal or only slightly inferior results from engines having compression pressures of from 10 to 15 atmospheres only, the details could be designed of lighter and less costly proportions, and recently several makers have sought to solve the problems in this connection. It is recognized that the oil engine of the future must be one that will not only work with refined oils, but also with heavier petroleum products, and be capable of dealing with any grade of fuel without any other alteration other than is necessary to control the speed of the engine by the automatic mechanism for injecting the fuel during a shorter or longer period as may be necessary.

A patent has recently been taken out by Thomas Browett of London, who, we believe, filled the position of manager of the Diesel Engine Co. for Great Britain and her colonies. Mr. Browett states that, instead of obtaining the necessary temperature by compression of pure air to something like 500 lb. per sq. in., an equal temperature can be obtained by compressing the air to say, 200 lb. per sq. in. only, but imparting additional heat to the air during such compression, so as to raise the compression temperature to the degree sufficient to give the proper working results.

In his specification, he shows in Fig. 1 a cylinder, A, having a port, E, which is uncovered by the piston, C, during its outward movement, at, or near the end of the expansion stroke. This port communicates with a chamber, D, which stores the hot gases, the ordinary exhaust valve, N, being afterwards opened in the ordinary manner, to get rid of the remaining gases. During the suction stroke of the Otto cycle, pure air

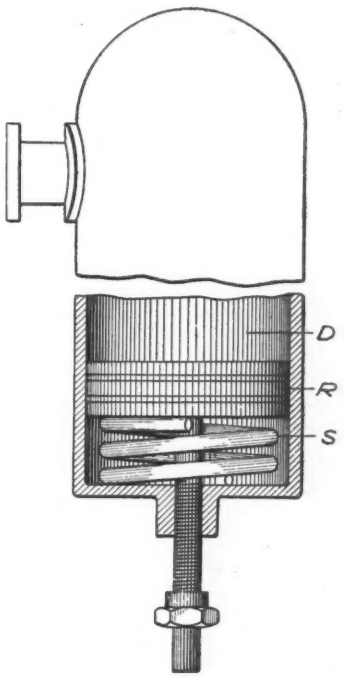


FIG. 2. METHOD OF REGULATING PRESSURE IN STORAGE CHAMBER

is admitted through the main inlet valve, B, and, as the piston nears the end of the stroke, the port communicating with the storage chamber is uncovered, and the gases being at a higher pressure than those in the cylinder, flow into the latter, considerably raising the prevailing temperature and also slightly increasing the pressure.

Upon the return stroke, the mixture of air combined with the heated exhaust products is compressed in the usual manner, the temperature at the end of the stroke being sufficient to ignite the liquid fuel injected by a still higher pressure as in the ordinary Diesel engine. In order to control the pressure and temperature at the end of compression, a valve, G, is provided, communicating with a relief valve, K, so that at a predetermined point of the compression stroke, say at half-stroke, if the pressure at that point in the stroke is higher than is desired, the relief valve opens and releases the gases under compression until the desired

pressure is attained, the gases passing the relief valve, K, being led into the main exhaust by the pipe, M. The final compression pressure, therefore, may be regulated by varying the load on the relief valve.

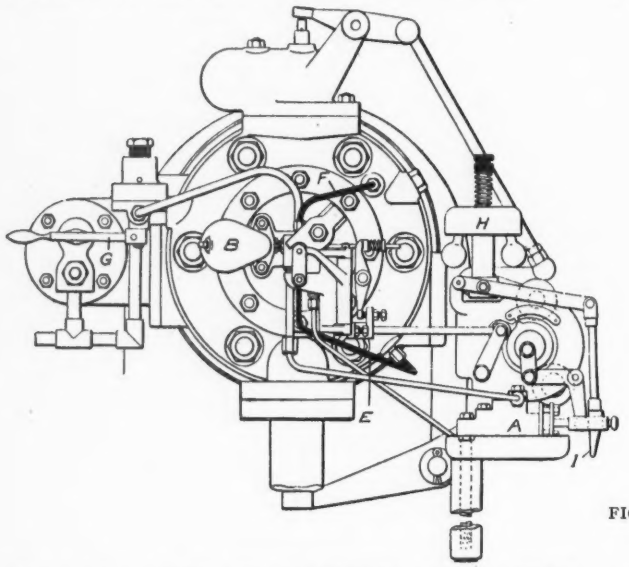


FIG. 3. END VIEW OF BLACKSTONE ENGINE VALVE MECHANISM

It will be noted that, by this cycle and arrangement the full volume and weight of air is always drawn into the cylinder up to the point at which the piston uncovers the port leading to the storage chamber, and then the products of the previous burned charge flow from the latter until equilibrium is established. These exhaust products contain always some air or oxygen or incompletely burnt hydro-carbons which are added to, and more or less intermingled with, the fresh charge of air.

In order to set the engine in motion, the receiver is first charged with air under pressure, and heated either before, or when in the receiver, by external application of heat. In order to prevent radiation and to retain the gases as hot as possible, the receiver is lagged with nonconducting material.

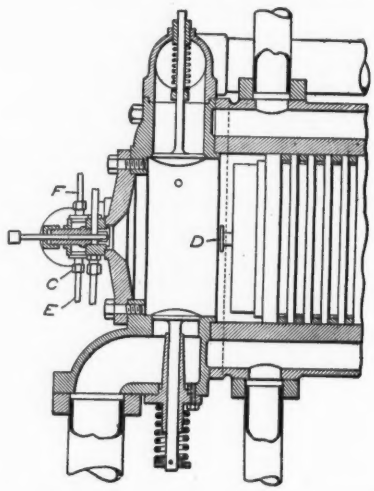


FIG. 4. SECTION THROUGH BLACKSTONE CYLINDER AND VALVES

Mr. Browett shows that his invention can be particularly well applied to double-cylinder engines, the latter being arranged so that the hot exhaust of one flows directly into the second cylinder during the suction stroke, the cranks being together. Similarly, any combination of cylinders can thus be arranged by suitable connection.

Another detail covered by Mr. Browett's invention is connected with the regulation of pressure in the storage chamber. A movable plunger, R, Fig. 2, may

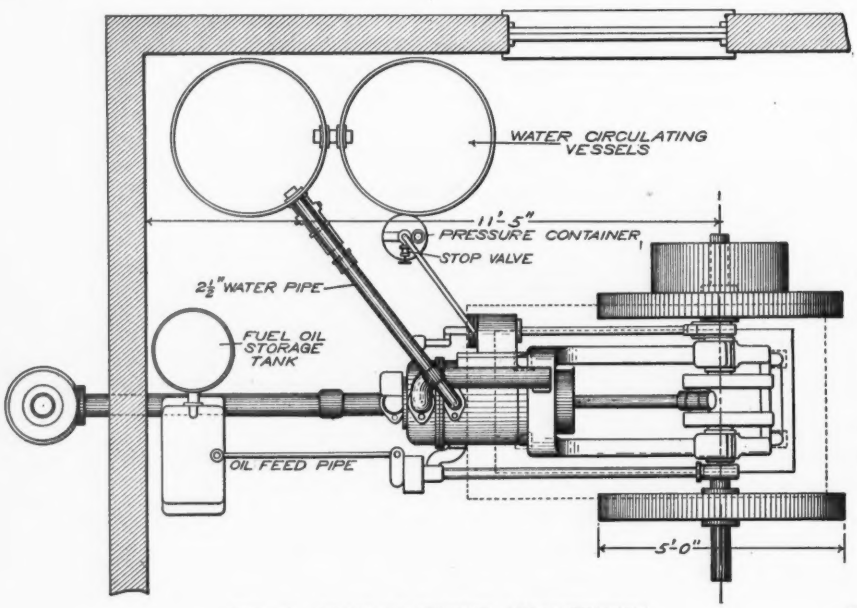


FIG. 5. PLAN OF ENGINE ARRANGEMENT

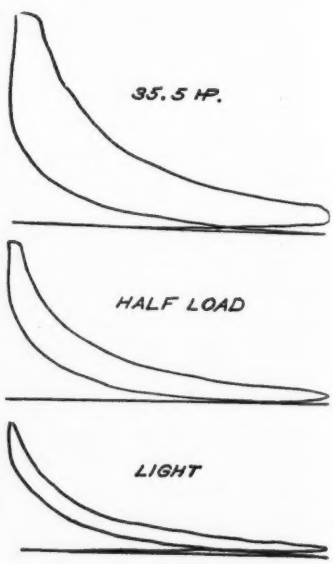


FIG. 6. TYPICAL INDICATOR CARDS

be provided, by means of which the piston is capable of movement against an air-cushion or spring-resistance, S, so as automatically to expand or contract the volume of the receiver, to suit the volume and pressure of the exhaust products passing into same.

An entirely different method has been followed by Messrs. Blackstone & Co., who are oil engine makers of Stamford, England, and have also given their attention to the design of an engine upon the Diesel principle but to work with comparatively low compression pressures such as 150 lb. per sq. in. The pure air is drawn into the cylinder during the ordinary charging stroke of the Otto cycle, and, at or about the end of the compression stroke, oil is delivered by a pump, A, Fig. 3, to an injection valve, the latter being provided with 2 passages, one in which the oil is first injected into an ignition bulb, B, and the other to an orifice at the end of the combustion chamber, C, Fig. 4, so that, upon subsequent admission of a charge of compressed air from a separate receiver at 400 lb. per sq. in., the auxiliary fuel is forced into the combustion chamber for a longer or shorter period of the stroke according to the quantity of oil pumped by the governing mechanism. This oil enters the cylinder as spray at the moment when the charge just previously admitted to the ignition bulb flashes out into the combustion chamber.

The port from the ignition bulb is arranged at an angle, so that the ignited vapor flashes across the spray, giving continuous combustion as in the Diesel type of engine. From the section, Fig. 4, it will be seen that a disk, D, is provided at the back of the piston against which the spray impinges, favoring diffusion of the fuel throughout the contents of the combustion chamber, and thus producing perfect combustion of the whole of the fuel supply.

The injection valve is water-cooled, inlet and outlet pipes, E and F, being taken from the main cylinder casing. The air compressor piston is worked by an eccentric from the crankshaft, and is connected to a small storage tank, as shown in the plan, Fig. 5. For starting, the ignition bulb, B, is first heated by an external lamp. When this is sufficiently hot, compressed air is admitted from the small pressure container to set the engine in motion. As soon as the first ignitions have been taken, one movement of the air control lever, G, stops off the compressed air from the cylinder, and opens the passages communicating with the fuel injection device, C.

The governor, H, is of the centrifugal type and raises or lowers (according to the load) a wedge-shaped piece of metal, I, which is interposed between the injection valve roller and the cam-shaft in such a way that, when full load occurs, a maximum amount of oil is delivered, and, under light loads, only sufficient to provide fuel for the ignition bulb. In consequence of this arrangement, the ignition bulb is supplied with a charge at each cycle, and the heat is therefore constant throughout the load range.

The excess of oil above the quantity required for the ignition bulb is deposited in the air injection device, and it is upon the latter that the variation in mean effective pressure is dependant. Three representative indicator cards are shown in Fig. 6, being respectively at full, half, and light load.

It is claimed that this engine has passed through its experimental stages and for some months an engine has been in practical operation in Ceylon attended only by a native laborer with the utmost satisfactory results.

An application of the same arrangement has been designed for use in connection with vertical engines

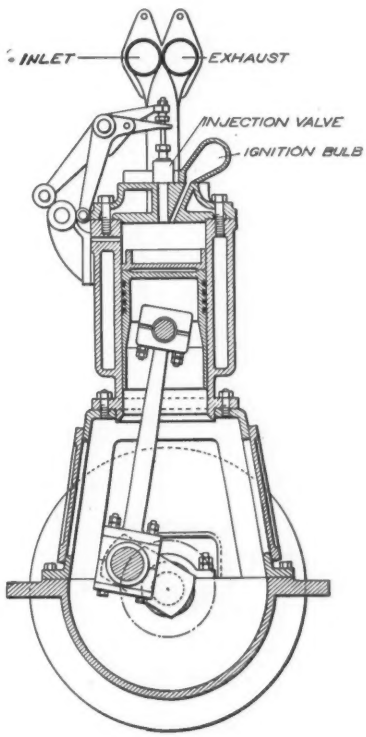


FIG. 7. ARRANGEMENT FOR VERTICAL ENGINES ON BLACKSTONE PRINCIPLE

for marine purposes, as shown in Fig. 7. The design includes a simple form of reversing mechanism. The liquid fuel is first cut off by a lever, which takes the resistance off the governor, and, at the same time, the injection air control lever is moved from the working to a neutral position, cutting off the compressed air from the injection device. The reversing lever is then pulled over which slides the camshaft into the position for reverse rotation.

When the engine is on the point of stopping, the compressed air control lever is pushed over to the starting position, and thereby, the engine starts in the required direction. As soon as this rotation has been effected, the compressed air lever is put into working position in connection with the fuel spray, the fuel pumps afterwards being restarted by the governor regulator.

REFRIGERATION

AMMONIA SYSTEM—OPERATION—BLOW-OFF OR PURGE VALVES

By Charles L. Hubbard

IN ORDER to secure the best results the ammonia system should be kept free from foreign substances such as oil, water, air, etc.

The presence of oil causes a coating to be formed on the inner surfaces of the evaporator, which acts as an insulation and reduces its efficiency.

The presence of water or brine causes an absorption of the ammonia, forming aqua ammonia, which raises the boiling point of the ammonia and causes material loss in duty.

Air in the system excludes an equal volume of ammonia gas, and therefore reduces the available condensing surface.

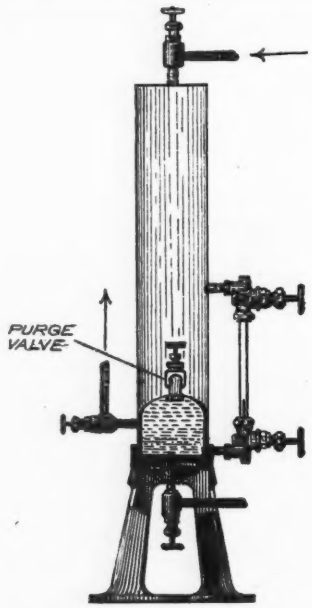


FIG. 1. PURGE VALVE ATTACHED TO OIL SEPARATOR

Position of Purge Valve

For the purpose of removing these undesirable substances, purge valves are provided in different parts of the system. One of these is commonly placed in the bottom of the oil separator for draining off the oil, which is brought over from the compressor. If a vertical ammonia receiver is used, a purge valve may be placed in the bottom, and the liquid ammonia be taken off from the side of the receiver 4 or 5 in. from the bottom. Other points of connection are the bottom of the brine cooler or lower manifold of the coil in the tank system. Special provision also should be made for air venting the condenser.

Testing and Charging

Before starting up a new plant, all parts of the system should be subjected to an air pressure and carefully tested for leaks. These can easily be detected in the parts which are submerged, by noting the rising air bubbles.

Those parts which are exposed should have a coating of lather brushed over the joints; bubbles forming at these points will also indicate leaks. It is common to put a pressure of about 300 lb. upon the compression side of the system.

The evaporator or low-pressure side should not be subjected to a pressure higher than that indicated by the gage, which is commonly about 120 lb.

In charging a machine with ammonia, the outlet valve from the receiver should be closed and the cylinder of anhydrous liquid ammonia connected with the charging valve of the evaporator. As the liquid ammonia flows into the evaporator it is vaporized and passes through the compressor into the condenser where it is liquified and flows into the receiver. When a sufficient quantity has been introduced, the cylinder is disconnected and the supply valve between the receiver and evaporator opened, and the operation is complete.

Cleanliness

One of the first points to be kept in mind in the operation of a refrigerating plant is cleanliness, and special attention should be given to the surfaces of the condenser and evaporator to obtain the best efficiency. Purge valves are always provided to assist in this as already stated.

Oil

Care should be used in lubrication, not to use too much oil. The oil should be of such a nature that it is not saponified by contact with the ammonia, as such a change would cause a thick coating on the inside surfaces of the pipes and other parts of the apparatus.

Oil should be drawn off from the separator about once a week, or oftener if there is danger of its being carried over into the condenser. If the oil is of the proper quality it should be in practically the same condition as before using and may be used over again after being allowed to stand until the gas has escaped from it. If it shows any signs of having been affected by the ammonia its use should not be continued.

Air and water should be blown out of the brine cooler and evaporating coil in the brine tank by means of the purge valves provided for this purpose. This should be done, however, only when there is a pressure on the system, otherwise air will be drawn in.

Removing Air

Air which collects in the condenser is commonly removed after the compressor has been stopped and

the condenser fully cooled by attaching a small rubber hose to the purge valves and submerging the end in a pail of water. If air or other gases exist in the system bubbles will rise to the surface of the water, while if ammonia is being blown off, it will be absorbed in the water and not rise to the surface.

Careful attention should be given to the strength of the brine in a system where this method is used, as a falling off in the capacity of a machine is often due solely to this one cause. Tests should be made frequently by means of a salometer to determine if it has become weakened.

Compressor Action

The compressor also should be watched to discover if there is any faulty action of the valves. This can usually be determined by placing the hand upon the inlet and outlet pipes.

Should the inlet pipe to one compressor, if 2 single-acting machines are used, or to one end of a double-acting compressor become warmer than the other, it

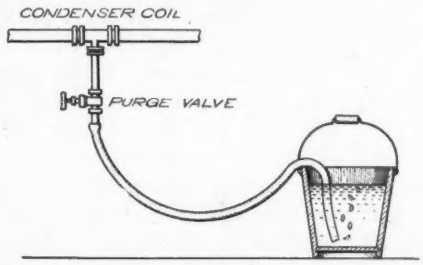


FIG. 2. METHOD OF REMOVING AIR FROM CONDENSER

indicates that the one having the warmer pipe is not working properly and the full amount of gas is not compressed at each stroke. This may be due either to more clearance or leaky valves. The relative temperatures of the pipes may also be determined by the appearance of the frost upon the outside.

The necessity of keeping the condenser free from air or other foreign gases has already been mentioned. In addition to this all deposits should be regularly removed from the outside surfaces.

Test for Water

If through leakage in the coils or other parts of the apparatus, water or brine becomes mixed with the ammonia, it may be detected by drawing off a small amount of the liquid in a test tube or other small receptacle. The ammonia will evaporate, leaving the water or brine in the tube, from which it is easy to determine the proportion present.

Ammonia Leakage Test

Great care should be taken to prevent the waste of ammonia through leakage. If the gas escapes into the air it is easily detected by its odor, but if the leak is in a submerged coil it is necessary to test the solution with which it is surrounded. In order to do this, certain chemicals are necessary. For example, phenolphthalen causes a bright pink color, Nessler's solution a yellow or brown color, and red litmus paper when dipped into the solution turns blue when ammonia is present.

REFRIGERATION HINTS

Much difference of opinion exists as to the proper size for the ammonia receiver in a refrigerating plant. Of course, a big receiver costs money, but it is a great convenience to be able to hold the entire charge of ammonia in the receiver in case of emergency. With a large receiver, which is not too full, an expansion coil can be repaired without shut down in the plant and the plant is much easier to operate when starting up.

A rule given by Siebel is that for an absorption plant, the receiver should at least hold enough liquid ammonia to bring the poor liquor at the bottom of the retort up to 73 to 77 deg. F. In a compression system, he would have the receiver which is placed between the condenser and the expansion valve hold 0.5 gal. of liquid for each ton of refrigerating capacity in 24 hr.

Another valuable service of the receiver is in acting as an oil trap and for this purpose it should be supplied with suitable glass gages and a valve for drawing off the oil at the bottom. A point which will help in the quiet running of the compressor is the use of large valve area so that the lift will need to be but a short distance. This can well be secured by the use of numerous small valves.

Brine Density

I am a subscriber to Practical Engineer, which I prize very highly. Can you give me a rule, or the exact amount of salt to bring my brine up to the desired percentage. The dimensions of the tank, and density of brine in my ice plant at this present time are as follows:

The tank is 20 ft. long, 14 ft. wide, 6 ft. deep, with 11 coils of pipe 2 in. diam.; the present brine density is 60 deg. We usually run it at about 90 deg. Would be much obliged if you could give me a rule to find how much salt to get. J. E. H.

A.—In regard to the density of brine, a tank 20 by 14 by 6 ft. would have 1680 cu. ft. From a table on the density of brine it is found that with a density of 90 deg. there will be 22.5 per cent of salt or 16.4 lb. of salt per cubic foot. At 60 deg. there will be 15 per cent of salt or 10.4 lb. per cubic foot. The difference between these is 6 lb. per cu. ft., which for 1,680 cu. ft. would be $1680 \times 6 = 10{,}080$ lb. of salt needed.

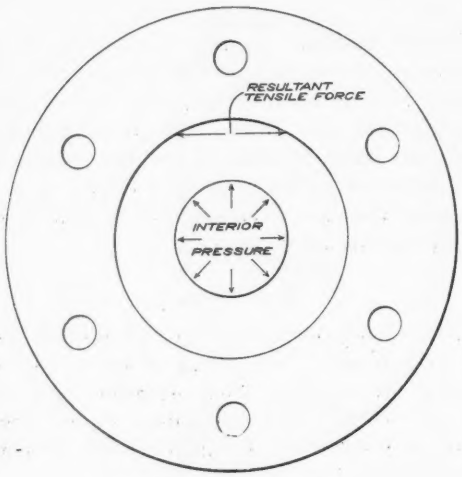
In Popular Mechanics a writer says that when the piston rings and walls of the cylinder of a combustion engine becomes worn, a simple way to improve the compression is to open the crank case and sprinkle about a tablespoonful of flake graphite in the front end of the cylinder. If this operation is repeated every 2 weeks, the graphite will fill the low or worn places and will bring the compression up to normal again.

SHEET PACKING

By W. E. Sanders

We have discussed packing where ½ of the joint was movable, i. e., rod packing. We now take up a packing used where neither part of the joint is movable, in other words, sheet packing and gaskets. As before, our first step is to set forth the fundamental principles, and again we do this by illustration.

If we inflate a balloon we know that the more pressure we apply in inflating it the tighter is the balloon stretched. In other words, when pressure is applied from within outward the resultant force tends to tear the substance apart, and it takes tensile strength in the material to withstand this. That is to say, the strength of the balloon depends on the tensile strength of the fabric making up the balloon. In making a joint in a pipe line or valve chest the force that is exerted on the inside, which tends in every direction to blow the packing out, is resisted by the



PRINCIPLE OF A GASKET

tensile strength of the packing itself. A packing should therefore be strong.

Secondly, the packing owes some of its strength, or some of its resistance to being blown out, to the surface of the flanges. This is the same grip that is obtained when a man walks down a side hill and prevents him from slipping. A great deal depends in this case on the nature of the surface, whether it be rough or corrugated or smooth, but it may be said that there are no flanges in ordinary practice which ever present a surface that is too smooth; in fact, where a surface is smooth it generally is made so even that it can be used with another smooth surface and no gasket employed. The surface of a flange is, however, independent of the packing and not characteristic of it, so that it can to a certain extent be disregarded when comparing one form of packing with another

The extreme instance of packing depending on strength alone is a metallic gasket, while the extreme instance of packing depending on grip alone is the use of sal ammoniac in rusting together the joints of the pipes carrying hot air blast in a blast furnace.

The two essential qualities in a sheet packing or gasket are density and strength. To this might be added elasticity, and in some cases softness. We cannot classify sheet packing quite as clearly as we can rod packing, but will have to make our comment, as to the place where each is to be used, as it is described. We will classify these packings as follows:

(a) Cloth Insertion Packing. This packing, which includes cloth insertion, cloth-one-side and cloth-both-sides, has degenerated. There was a time when the rubber compounds used with these were first-class, but that time is passed. Competition has forced the quality down, together with the price, so that now it is cheapest in cost and its quality is the poorest. There are, of course, good C. I. packings, but we refer here to the average as sold on the market. For cold water, or service where the pressure is very light, these packings will give satisfaction. They owe their merit chiefly to the tensile strength of the cloth.

(b) Red Sheet Packing. Red sheet packings in general have tensile strength and elasticity. Some of them are dense and some are not. When purchasing these packings the buyer gets about what he pays for. To get a first-class red sheet a high price must be paid. Red sheets can be gotten quite cheap, but those are not good, having little tensile strength and being so soft that they need immediate following up. For ordinary pipe line construction it is generally customary to use a red gasket, and this class of packing is well adapted to the service.

(c) Self-Vulcanizing Sheet Packing. This packing has never been cured or vulcanized. It is generally black, and is made up with a large amount of mineral matter in its construction. It is made of a compound which when cured will be quite hard. As it is sold uncured or unvulcanized, the effect of heat is to vulcanize it in the joint. It will, under those conditions, become as hard as a rock, and cling very fast to the metal. Before becoming hard, however, it softens up, and until it has had a chance to cool it is liable to blow out. It has no elasticity and for any service in a vibrating line, or for a line that is subject to expansion and contraction, it is not the best packing to use; but for valve chest covers or any service where there is little or no vibration it will give excellent results, if care is taken when put in to follow up the joints and see that they are properly cooled or quenched. After that they will last indefinitely.

(d) Oilproof Packing. For conditions where it is necessary to resist oil, or for general steam conditions, where a higher class of packing is desirable, these oilproof packings are good. The best comes from Germany and is quite expensive, and as it comes in sheets instead of rolls, there is more waste than with American packing. The American packings known as oilproof will grade anywhere from a few

that are very nearly as good as the foreign down to some which have no right to the name, oilproof. As in the case of red sheet packings, the buyer will get what he pays for.

(e) Asbestos Packing. Sheet packing has the same difficulty to overcome that rod packing does. Where sheet packing is made of rubber the rubber is liable to be affected by high temperatures, and as the gaskets are almost always in constant contact with live steam, it can be seen that the rubber is going to be burned out sooner or later. That is to say, the gasket will gradually harden and lose its elasticity. With the better grades this process is longer delayed; with a poor packing it occurs very soon. For very high temperatures and for superheated steam this process of hardening and burning out occurs quickly, hence, it is best to use asbestos packing, generally in the form of a cloth with a wire insertion running through each thread and the whole covered with a rubber compound containing as little rubber as possible, but serving to waterproof the whole packing. The great difficulty with packing of this sort is that it is very hard to cut and wherever possible it is better to use a gasket made up at the factory where the cloth is folded in on itself. This makes a very strong gasket and one that will last indefinitely.

(f) Fibre Packing. A packing that has lately come on the market is formed of fibers which are put together in somewhat the same way as paper or pasteboard, and subjected to very high pressure. This packing has great tensile strength, more so than any rubber packing, but less elasticity. It is, however, giving very good results, and, while high-priced, in difficult places it will more than pay for itself.

As a general classification:

For cold water and low steam pressures use a, b, d or f.

For hot water and average pressures of steam use b, d or f.

For steam pressures from 100 to 150 lb. use b, c, d, e or f.

For pressures above 150 lb. use e, f or c.

For conditions subject to dry heat and high temperature use e or c.

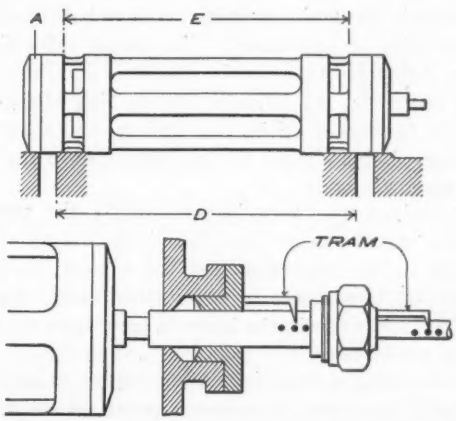
Metallic Gaskets. A number of styles of metallic gaskets are now made, some of them of metal only, and some of them of metal with a compound. For joints that are not to be broken these gaskets serve very well and are perhaps more satisfactory than a soft gasket. If, however, the joint has to be broken and made over again, a soft gasket may give better satisfaction, since it accommodates itself to the shape of the flange very readily.

Sheet packing should not be condemned after an unsatisfactory trial unless it is certain that the conditions of application were right. An expert steam fitter can put in 2 gaskets apparently the same, yet 1 of them will blow out quickly and the other will last for some time. The difference arises in the cutting of the gaskets and also in placing them in position. A gasket should be placed in position and the flanges drawn up so that they are parallel to each other all the time they are being drawn up. This means drawing up the bolts partially from one side and then the other, and never drawing any one bolt up snug before touching the other bolts, nor ever drawing up the bolts on one side before touching the other side. If this is done, it will result in squeezing the gasket to one side, putting the packing on one side under a tension at the start, and making the gasket thin on one side and thick on the other. It is probably very seldom that gaskets are intentionally put in wrong, but when comparing different packings care should be taken that each of them is given the same application.

SETTING THE RIDING CUTOFF PISTON VALVE

WHEN it becomes necessary to set a riding cutoff piston valve, such as is employed in the Buckeye engine, and the shop marks have been removed in some manner, the work is somewhat more difficult than that necessary with ordinary slide valves. To re-establish the shop marks on the valve stems it is necessary to remove the valves as the working edges cannot be seen when the valves are in place.

Before beginning the work of setting the valve one should provide himself with a tram, or a gage,



METHOD OF SETTING RIDING CUT-OFF VALVE

such as shown in the illustration and place the valves on a bench or a clean floor. The first adjustment is to place the cut-off valve in the position of mid travel and by use of the tram, as shown, mark this position permanently by means of a punch mark on the valve stem. Next push the cut-off valve along until it closes the port in the main valve and again by the use of the tram, mark this position on the stem. The valve is then pushed in the other direction until it closes the port in the main valve and this position is marked on the stem as in the other case.

The next step is to remove the cover, A, on the main valve, take out the cut-off valve and measure the

distances D and E. Place the main valve in the chest and move it along until the port in the main valve opens into the cylinder wide and almost closes it again, leaving the port open to the amount of lead, which may be seen or determined by a piece of thin steel in the smaller sizes; this should not exceed 1/16 in. Mark this position of the valve on the main valve stem with the tram placed against the gland as shown in the illustration. Then push the valve along still further a distance equal to D minus E plus ⅛ in., if the lead is 1/16-in., when the port in the main valve will have opened the port into the cylinder at the opposite end 1/16 in. Using the tram, this position is marked on the valve stem of the main valve.

The cut-off valve is now placed in position and the cover A is put upon the main valve. Connect the main valve rod to the valve stem and turn the eccentric from one dead center to the other, seeing that the outer marks on the valve stem move an equal distance beyond the point of the tram. The outside marks do not represent the travel of the valve, but twice the lap plus twice the lead; therefore the outside marks will have moved an equal distance beyond the point of the tram when the eccentric occupies either dead center. If they do not adjust the length of the eccentric rod until these positions are fulfilled.

Now place the main valve in its position of mid travel which may be accomplished by means of the marks on the valve stem and the tram. Tighten the set screws in the main eccentric so as to hold the valve in its position of mid travel. The cut-off valve should then be connected up with the eccentric and the length of the eccentric rod adjusted by turning the cut-off eccentric (governor wheel) around on the shaft, this adjustment being similar to that employed in the main valve eccentric rods.

The valves may now be set exactly the same as the slide valves except that the piston valves are set according to the marks on the valve stem instead of by sight as is possible in the former case. Full instructions are given in the issue of July, 1908, to which readers are referred.

When using a tram in setting engine valves, it is absolutely necessary to select a point on the engine which will not be affected by future adjustment and which will permit the tram to be placed parallel to the valve stems or other rods upon which similar measurements may be taken. A slight variation in the position of the tram may cause the lead to be doubled at one end of the valve and eliminated at the other. A good method and one which is recommended by the engine manufacturers, is to remove the packing from the stuffing-box, clean the surfaces and push or screw the gland up until it is tight against the base of the stuffing-box. This permits the tram or scale to be placed on the stem and against the gland, the latter becoming a fixed point under these conditions.

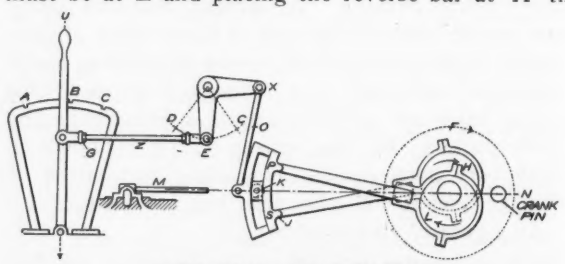
ONE ENGINE HORSEPOWER will give current for 10 16-c.p. lamps using 3.6 watts each.

SETTING A LINK MOTION

By C. R. McGahey

THE main trouble experienced by the ordinary man in setting a link motion gear and valves is that he will try to set the entire gear without any system whatever in his work. Now why not consider the gear as a simple valve gear; that is all you have when you go at it right. You cannot handle the whole gear at once.

To set a simple link gear, in the first place we will see that our quadrant and rocker are in the proper position, as this is a vital point in any link motion. The troubles found in the ordinary valve gear are not so frequently found in the locomotive gear as the reach rod and link hangers are made with fixed centers and when once right can get out of place only by wear, but in many gears the reach rod from the quadrant bar to the rocker arm are made with adjustment threads and lock nuts as shown at G in the accompanying drawing and by lengthening or shortening this rod the point X on the rocker can be raised or lowered at will, which will affect the position of the main link block, which transmits the movement of the eccentric to the valve proper, so when the reverse lever is on the center of the quadrant at B the rocker must be at E and placing the reverse bar at A the



LINK GEAR ARRANGEMENT

quadrant must fall to position D and when thrown forward must fall to position CC, and at the same time the link block must make its proper positions when the gear is on center as shown in the drawing, with quadrant bar in mid position, the arm of the rocker at E and the link block on the center line M and N.

In case the link hanger is of the solid type, should the link block fall below the center line, it will be necessary to lengthen the rod Z to bring this block on a center line, but on the gears that have the rod O adjustable, the adjustment must be made at this point, having the rocker properly adjusted to travel on the points D E C; and having the link block set in the right position, then the valve in this mid position of the valve gear should take an exact central position as shown on the drawing.

Now having the quadrant bar in central position, and the rocker adjusted to swing evenly on each side of the center line E, should the distance be 5 in. from C to E, then the distance D E should be the same and this will throw the link block an even distance on each side of the line M and N, giving a true transmission of the movement of the eccentric. These points are

important in any link motion and should be thoroughly understood as being of such importance.

Having gone over these points carefully and having the valve in mid position we are now ready to set the eccentrics. Remember that we only set one at a time. Should we want our engine to go forward with the eccentric H in action, or go forward in the direction of the arrow F, we place the reverse bar in the notch C, which brings the rocker on point C and raises the position of the link S on center with the block K, and this center J must coincide with the center line M N when in this position.

In this position with the crankpin on the center line M and N, the valve on an ordinary engine should show a slight opening, say 3/64 in. If it does, this eccentric is in the correct position. Should the valve show no opening, we must move the eccentric ahead in the direction shown by the arrow, remembering that it is the eccentric H that is moving the valve and that the eccentric L has nothing to do with the movement of the valve in this position, provided you have all on center as plainly set forth. But should you fail to have the point S on center with line M and N, then the dead eccentric will come into play and you will have all kinds of trouble with your valve gear in setting and running; then you will have 2 to set, which no one can do successfully.

Should the valve show too much opening when this pin is in the position shown, it will be necessary to move the eccentric in the reverse direction or backward until you have the proper opening or what is usually called lead.

We have been considering this gear with the plain D valve taking steam over the outside edges. Should you have a plug or piston valve taking steam on the inside edges, the movements would be the reverse and the quadrant would take the position at A for the forward movement. I mention this as it might cause confusion to someone having a balanced plug valve taking steam on the inner edges.

So far we have the gear all set and the one eccentric right, so that all that remains to be done is to set the backing eccentric. We set the reverse bar at A, using the style of valve shown, the plain slide or D, as usually termed. This places the center on the link block at P on line M and N, which must fall true, as shown, then the crank being on center the valve should show the same opening as on the opposite end of the cylinder. If it does not show opening enough, the eccentric must be moved in the opposite direction of the first setting until you have the 3/64-in. opening as in the first setting. Should the valve show too much opening, you must move the eccentric in the opposite direction. When this is done, you will have a properly set valve gear of the link or reversible type, which is just as simple to set as a single eccentric when considered as shown, being a single eccentric gear, as one eccentric is always thrown out when the other is in full action.

The writer has set large gears on heavy reversing engines in the short time of 30 min., using 4 men dismantling and setting under instructions on heavy incline engines that do continuous service.

STEAM CONSUMPTION FROM THE INDICATOR DIAGRAM

BECAUSE of the errors that are liable to be involved in this method of getting at steam consumption, it is really hardly more than a guess, but as a large number of engineers seem to be interested in the matter, we are presenting this article for their benefit.

The diagram does not show the steam condensed during the period of admission into the cylinder, nor is there any means of finding out the wetness of the

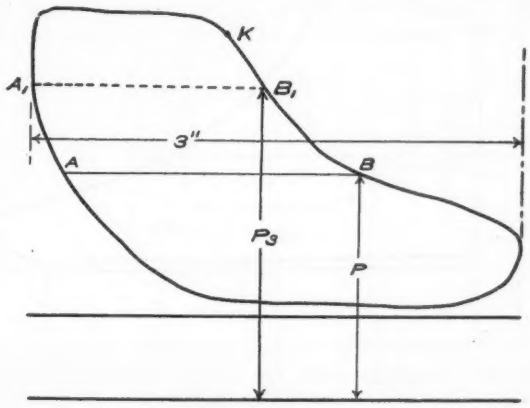


FIG. I. DETERMINING STEAM CONSUMPTION ON A HIGH-SPEED DIAGRAM

steam in the clearance space during the period of compression, so that these errors cannot be taken account of in the diagram estimate for steam used.

Process

Two cases will arise, one in which the compression curve carries above the terminal pressure on the expansion line and the other in which it does not. For the first case, draw the line AB, Fig. 1, one end of which lies in the compression curve and the other in the expansion curve, this line AB being parallel to the atmospheric pressure line. The total length of the card represents the amount of the piston displacement in cubic feet, and the volume of steam represented by the length AB, which is the volume taken per stroke, will be to the total piston displacement as the length AB is to the total length of the card. This gives the volume of steam taken in per stroke and from steam tables we find the weight of a cubic foot of steam, at the pressure P corresponding to point B and multiply this by the volume represented by AB to get the weight of steam per stroke. Multiply this by the strokes per hour and divide by the indicated horsepower and the quotient will be the pounds of steam used per horsepower per hour, no account being taken of clearance and condensation loss.

For the second case, where the compression curve

does not run above terminal pressure, a point E on the expansion curve, Fig. 2, must be taken, and the volume represented by FE in cubic feet multiplied by the weight of a cubic foot of steam at pressure P_1 for the point E. The volume represented by CD must be found and multiplied by the weight of a cubic foot of steam at the pressure P_2 at point C. This gives the weight in the cylinder during expansion and in the clearance during compression. Subtract the second product from the first to get the steam used per stroke and then multiply by the strokes per hour and divide by the indicated horsepower, to get the pounds of steam used per horsepower per hour. The line FD

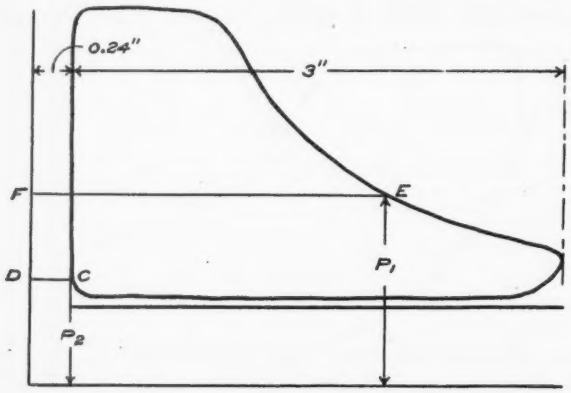


FIG. 2. DETERMINATION OF STEAM CONSUMPTION FOR CORLISS DIAGRAM

is laid off at a distance from the end of card equal to the clearance, and the pressures in all cases are measured from the absolute zero pressure line which is laid off below the atmospheric pressure line.

To illustrate the method by solving a problem taking the second case as it is the more complicated of the two, if an engine has 24-in. stroke, 10-in. diameter, and the length of the diagram is 3 in., the volume represented by this length will then be the area of the piston times the length of the stroke. The area of a 10-in. circle in square feet is 0.546 and this times the length, 2 ft., is 1.092 cu. ft., the piston displacement. If the clearance of the engine is 8 per cent, it will be represented by a line 0.08×3 equals 0.24 in. long and the vertical line to indicate the clearance volume will be erected at this distance beyond the admission end of the card.

If the distance EF be 2.15 in., the volume represented by this length will be $1.092 \times 2.15 \div 3$ equals 0.781 cu. ft. If the scale of the diagram is 40 lb., pressure P_1 will be 45 lb. and from the steam tables the corresponding weight of steam per cubic foot is 0.1077. Multiplying this by the volume 0.781 gives 0.0841 lb. as the steam in the cylinder during expansion.

The length DC equals 0.24 in. and the volume represented equals $1.092 \times 0.24 \div 3$ equals 0.00874 cu. ft. The pressure at C is 25 lb. and the weight per cubic foot corresponding from steam tables is 0.06199 which multiplied by 0.00874 equals 0.0000542 lb. Subtract this from 0.08410 leaves 0.08405 lb. of steam taken in per stroke.

If the engine makes 100 revolutions a minute, and is double-acting, the strokes per minute will be 200 and per hour 200×60 equals 12,000 and the steam used per hour will be $0.08405 \times 12{,}000$ equals 1,008 lb. The mean effective pressure of the card is 40 lb. and the horsepower corresponding to this is 38.1 so that the steam per horsepower hour is $1{,}008 \div 38.1$ equals 26.45 lb.

In some cases this process can be simplified as follows: If the point A_1, Fig. 1, be taken at the end of compression and the length A_1 B_1 be expressed as the

CORRECTION TABLE FOR INITIAL CONDENSATION FOR STEAM CONSUMPTION BY DIAGRAM

PERCENTAGE OF STROKE COMPLETED AT CUTOFF	PART OF FEED WATER ACCOUNTED FOR BY THE INDICATOR DIAGRAM		
	SIMPLE ENGINES	COMPOUND ENGINES H.P. CYLINDER	TRIPLE EXPANSION ENGINES H.P. CYLINDER
5	0.58	——	——
10	0.66	0.74	——
15	0.71	0.76	0.78
20	0.74	0.78	0.80
30	0.78	0.82	0.84
40	0.82	0.85	0.87
50	0.86	0.88	0.90

percentage of the stroke, we then have the length A_1 B_1 times the weight of a cubic foot of steam at a pressure P_2 times 137.5 divided by the mean effective pressure gives the amount of steam per horsepower per hour. In Fig. 1, A_1 B_1 equals 1.42 in. or 47.3 per cent of the length of the card. The pressure P_2 is 55 lb. and the corresponding weight per cubic foot is 0.1736 lb. Then $47.3 \times 0.1736 \times 137.5 \div$ by the mean effective pressure which is $40.4 = 27.95$ lb. of steam per horsepower-hour.

By means of the table shown, this can be approximately corrected for the initial condensation. For the cutoff of the engine, find the length out to the point K, and divide this by the length of the card. In this case $1.18 \div 30.394$ or 39.4 per cent, which is nearly 40 per cent, and for a simple engine, the correction factor at 40 per cent cutoff is 0.82. Dividing the steam consumption 27.95 by the factor 0.82 gives 34.05 as the pounds of steam per horsepower-hour corrected for the initial condensation.

A CONVENIENT RULE OF THUMB for ascertaining approximately the size of engine required to drive a direct-current dynamo is to multiply the kilowatts of output by 1.7 for small machines, 1.6 for medium sizes and 1.5 for 500 kw. or over. The result will be about the brake horsepower required.

FOR PRESERVATION OF WOOD, 2 substances are used largely in the United States; the first, creosote, and the second, zinc chloride. One gallon of creosote or ⅓ lb. of zinc chloride will protect a cubic foot of timber from decay.

QUESTIONS AND ANSWERS

Our readers are invited to send in their troubles and problems; also to answer questions which are asked. All letters must have name and address of writer, which will not, however, be published. If answers are wanted by mail, send stamp for reply.

Motor Connections

1. How should I proceed in making the connections to a 10-hp. shunt-wound direct-current motor for 110 volts?

2. In connecting to line, how can I determine the positive and negative ends without the aid of instruments?

3. Also how can I find the positive and negative pole pieces and how must they be placed in relation to the brushes?

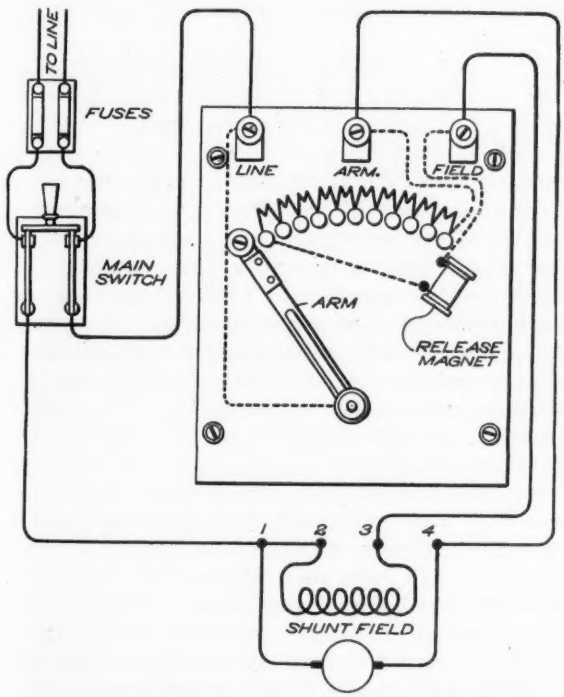


FIG. 1. CONNECTIONS OF SHUNT WOUND MOTOR

A.—1. Connections for a shunt-wound direct-current motor are as indicated on the diagram herewith. You will, of course, use the starting box and on this you will find 3 terminals, 1 marked "main," the 2nd marked "armature," and the 3rd marked "field." The connections on the starting box should be as shown in Fig. 1.

If your starting resistance has no field connection post, then the field of the motor would be connected directly to the line, as indicated in Fig. 2.

2. So far as the running of the motor is concerned it makes no difference which is positive or negative of your line wires. The motor will run in the same direction so long as you do not change the field connection on the machine. In order to determine the positive and negative the best way is to put the 2 bared ends of the line wires into a bucket of water and the end which gives off the greater amount of gas will be the negative wire.

3. Positive and negative pole pieces of the motor will take care of themselves. The only way you can test these out is by the use of a pocket compass. The north end of the needle will point toward the negative magnetic pole.

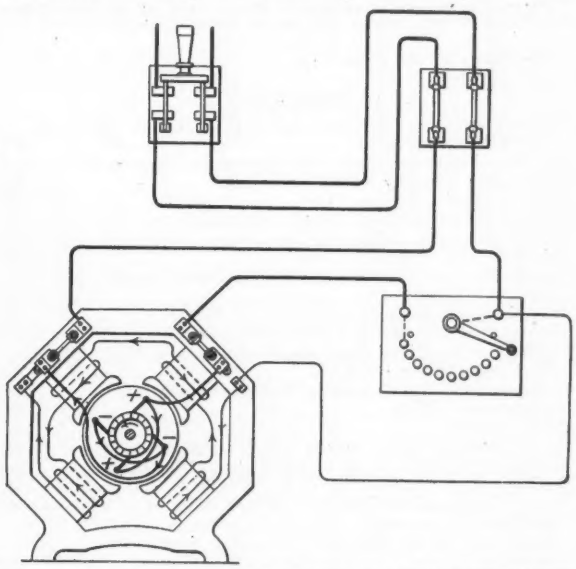


FIG. 2. MOTOR CONNECTION WITH ARMATURE RESISTANCE COIL STARTER

The brushes are usually designed to stand either opposite the middle of the pole pieces or half way between pole pieces, depending on the way the armature is wound.

Flux to Solder Cable to Carbon Brushes

Will some one please tell me through Practical Engineer what soldering flux to use in soldering copper cables to carbon brushes, and how to use it?

We have 2 old-style alternators for which we cannot get brushes ready made, so have to get the carbon in bars and make them ourselves, and we have some trouble in getting the cable connections to stick to the carbon. W. C. R.

Freezing Steam Pipe

Would some engineer kindly tell me how to freeze a pipe under 60 lb. of steam pressure to put on a new valve? C. A. R.

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PRACTICAL EDUCATION

By the appointment of J. C. Jorgensen to a professorship in Columbia University, that institution has taken a pioneer step in practical education in engineering which has been a long-felt want in our industrial development. Mr. Jorgensen has, for a number of years, been chief engineer of the St. Regis Hotel plant in New York city and is thoroughly familiar with the practical side of power plant engineering from the coal heap to the test for economy.

While our principal universities and technical schools aim to turn out engineers with sufficient knowledge to superintend a power plant it is a fact that the vast majority of graduates are compelled to devote a number of years to the application of engineering principles which were learned in college before they are able to gain a sufficient grasp of their profession to make them economical adjuncts to any power plant.

The trend of our entire public school system seems to be toward culture and deep science while the working people or semi-professional men must, even at this day when every community has its public schools, work out their callings by personal experience as did our ancestors hundreds of years ago. Our universities have added engineering courses, so called, in order to meet a demand for a course that would put to practical use the principles of chemistry, physics, etc., which scientists work out in laboratories on a small scale. In these departments they have put instructors who are specialists in their lines, mathematicians, electricians, physicists, but it is rarely that there is found a man in a college chair who has made a success as a practical engineer.

On the other hand we have numbers of men who have made wonderful success in engineering lines who started as boys apprenticing themselves for a term of 2 to 6 years to some practical man well informed in his trade and who have never taken a technical course. These men have put into industrial use principles which scientists have done little more than play with.

While it is true that there is no engineering school of note in this country without its shops, the tendency even here seems to be for a department conducted on the laboratory plan with little or no stress laid on the efficiency or economy of the operations performed and the individual aims of the student are ignored. Any one taking instruction in lathe work gets a given training, whether he intends to be a machinist, designing engineer, consulting engineer, operating engineer or commercial engineer. Little distinction is made in mathematics taught to engineering students and to those specializing in mathematics. The same may be said in regard to physics, chemistry, English, political economy or any branches of the course other than those which are of interest only to men taking up one particular line of work and these courses in the curriculum of any college are few.

What we need in our school system from the primary grades up, is courses of instruction that will,

every year, develop the usefulness of the student to his fellows. A well-grounded foundation through the grades is essential. The individual tastes and abilities should then be considered and courses leading direct to their full development established.

The wonderful increase in attendance at technical schools is due to a demand by the industrial world for practical men with brains and not for the scientist with his expensive experiments.

Columbia University is, therefore, to be congratulated on taking this step towards more practical education and is fortunate in securing Mr. Jorgensen who stands high as a practical man. For a number of years he has conducted an apprenticeship course, in the power plants under his care, upon the European plan, and after 5 yr. of continuous good work recommended apprentices for an engineer's license to the city authority. It is the plan of the university that Mr. Jorgensen is to give its engineering students a similar course of instruction. The results obtained will be watched carefully by all interested in the engineering field, and should lead to the establishment of courses in practical engineering in all branches in all state universities if not in all engineering colleges.

EDITORIAL CHAT

Exhaust or Live Steam

If you wanted to get a room hot, would you take hot or cold steam to do it, and would it take more of the hot steam or of the cold steam? That is the substance of a query that has caused a whole lot of trouble and maybe some black eyes. The terms "hot" and "cold" steam are rather queer, but the distinction is one which you will recognize, hot steam being live steam which has been put through a reducing valve to cut down the pressure, and cold steam that at a less temperature which has been taken from the exhaust of a pump or engine.

Now, on the face of it, the hotter the steam the more heat ought to come out of it, and if there is more heat in it, as there must be when it is hotter at a given pressure, why can't you get more heat out of it? Yet the fact has been quite clearly brought out that exhaust steam for certain conditions seems to give more heat than live steam which has been pushed through a reducing valve. Now, what is the wherefore of this, and is it really so or does it just act as if it were so?

An experiment made with live steam and a water jet has brought out a new idea and perhaps it is a key to the apparent contradiction. In this experiment, live steam was put through a reducing valve and just beyond this valve not a mild, gentle shower of spray was introduced, but a whole water spout, so that the steam took up all the water it could possibly carry at the new and low pressure. It was then sent about its business through the heating system.

With this condition it was found that the live steam throttled down was just as effective as the exhaust steam, but when the reducing valve was used without the spray, considerable increase in the amount of steam necessary to heat a given building was noticed. The secret of the whole matter is that when you want to do heating with steam you have to get the heat out of it. It doesn't make any difference how much money a man has in his pocket, if he won't give up when you want to borrow $5 it won't help you any, so no matter how much heat there is in the steam, if you can't get it, it doesn't help much in heating a building, and steam that is superheated by wire drawing through a reducing valve is just that stingy that it will not give up heat. It is a good deal like human beings; after it has been irrigated a little it begins to loosen up and you can get some of its possessions away easily. The exhaust steam is wet anyway, and when it rubs up against the radiating surfaces, the heat hustles out into the air of the room.

A fact which shows up this proposition is the use of superheated steam in engine cylinders. There it is used to prevent the heat from escaping to the cylinder walls. In the same way, if the steam is superheated in a radiator, the heat does not go to the room but just jogs along through the pipe with the steam and is given up when the steam condenses in the receiver or returns.

Of course, if the system is absolutely closed tight and the heat is bottled up where it can't get away, it must go back into the boiler, giving hotter feed water, so that there is nothing lost in the end, but it will take more pounds of steam passed around through that heating system when it is superheated than when it is wet in order to keep the building warm. A proof that this is so, if you stick your hand in a jet of superheated steam as it blows from a pet cock under high pressure, it does not burn the hand. If you start to stick your hand in the wet steam coming from the exhaust of a steam engine, you won't; you will take it out.

The meat of this proposition comes down to that same water spray mentioned heretofore. If you have to use live steam for heating and throttle this through a reducing valve, then uncovered pipes leading from the reducing valve to the heating system will make the system more effective. That doesn't sound like horse sense and it isn't if the steam cools off beyond the point where it is wet enough to give up heat to the radiating surfaces rapidly. If the radiation is attached to the mains close to the reducing valve, then the water spray seems the proper thing.

One wild enthusiast was so vigorous as to declare that by putting his steam through an engine running idle instead of through a reducing valve he saved 50 per cent of the amount of steam required to heat a building; and then one of those fool reasoners that always wants to carry things to a logical conclusion said, "Why not put it through 2 engines and save it all?" Anyway the steam jet is an easy proposition to install and looks like it has reason behind it. It certainly is easier to look after than running the steam through an idle engine, besides saving wear on the engine bearings.

ELECTRICAL MACHINERY AND APPARATUS

A TALK WITH A CHIEF ENGINEER

By Wm. Kavanagh

Truing Up a Commutator

KINGSLY and I took the occasion to visit the chief one time when he was preparing to turn down a commutator. The commutator needed truing up badly and as the chief had no spare armature of this size on hand he was anxious to have the job done as quickly as possible, so that the motor to which the armature belonged could be placed in operation. The armature was used on a 35-hp. motor that operates a blower for one of the cupolas in the foundry department and it was necessary that the motor be ready by the time the cupola was charged.

After the chief had given some orders to his assistant he said that "the turning up of a commutator involved a knowledge of the machinist trade and

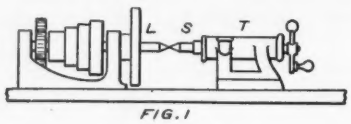


FIG. 1

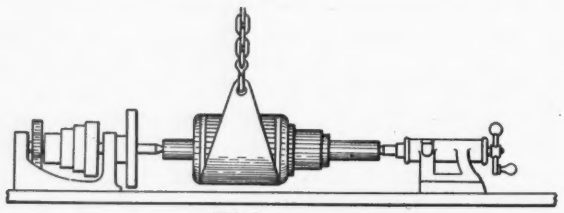


FIG. 2

FIG. I. CHECKING UP LATHE CENTERS
FIG. 2. PLACING ARMATURE IN LATHE

before the armature was placed in the lathe the first thing to do would be to find out if the lathe centers were in line. In order to do this it becomes necessary to place the centers in the live and stationary spindles and learn whether they are in line or not." Here the chief drew a sketch like Fig. 1, and continued: "The centers are shown at L and S and by moving the tail stock T until the center S is in contact with the center L; then if they are out of line it will be seen immediately. Sometimes, if the centers are out of line you can move the slide head of the tail stock, and by doing so you probably can bring the centers in line. If they cannot be lined up in this way then of course the centers will need to be trued up. After being satisfied the centers are in correct position the slide head can be tightened so as to prevent any possibility of moving the center out of position.

"After the operation of placing the centers in line is over, measure the length of the armature shaft and slide the tail stock back on the lathe a few inches over this distance then and make the tail stock fast so as to prevent any slipping when the armature is placed in the centers."

Figure 2 shows the means adopted by the chief for placing heavy armatures in the lathe. "Directly over the lathe is fixed an eye bolt from which is suspended a chain hoist; the armature is placed in a heavy canvas sling, as shown, and hoisted by means of the chain tackle sufficiently high to bring the centers of the armature shaft in line with the lathe centers, when the armature can be placed in position and ready for work. Of course the dog which engages the chuck is first put on the armature shaft before it is hoisted into position on the lathe centers; this obviates unnecessary hoisting and lowering of the armature.

"After the armature is in position the armature shaft should be tested for true running, as the commutator is turned down according to its rotation; if

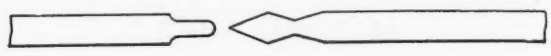


FIG. 3

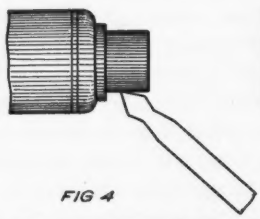


FIG 4

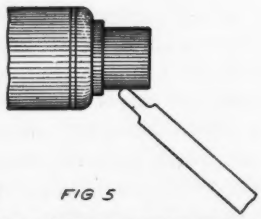


FIG 5

FIG. 3. ROUND NOSE AND DIAMOND POINT TOOLS
FIG. 4. POSITION FOR HOLDING DIAMOND POINT TOOL
FIG. 5. POSITION FOR HOLDING ROUND NOSE TOOL

the shaft runs out of true the commutator will be turned out of true, and hence it is important to have the armature shaft rotate in line with the lathe centers." At this point in the chief's conversation Kingsly wanted to know what kind of a tool was used in turning down the commutator and also how the chief would proceed to set the tool in position. In answer to these questions the chief said that 2 kinds of tools were used, some preferred the side diamond point while he liked the round nose tool best. The chief thought the selection of a turning tool was merely a matter of fancy, the whole secret of turning lay in how to apply the tool and in keeping it well sharpened during the operation of cutting. "A dull tool," continued the chief, "digs into the copper and causes considerable trouble and labor to erase the indentations or marks left from its use and improper application."

Here the chief drew the side diamond point and round nose tools, as shown in Fig. 3, and continued: "After the tools are ground they should be sharpened to a keen edge with an oil stone, and this edge should

be maintained during the operation of turning. In setting the tool, it is placed in the tool post and the tool is advanced towards the lathe center. The object of doing this is to learn how high or low the cutting point of the tool is above or below the axial line of the commutator; if the tool is below this line it will surely dig or gouge into the copper and cause trouble. For my part I prefer the cutting edge to be slightly above this center and to have the tool angled," as shown in Figs. 4 and 5.

"There are some things to look after during the operation of turning. You should first take a very light cut and continue this out to the end; in fact each cut should follow this rule. You should run the lathe medium slow, and after 1 or 2 cuts have been made over the surface of the commutator you will be able to determine whether the speed and depth of cut can be increased. One of the great mistakes with the novice in lathe turning is to try to take off too much metal at once; if you take your time in turning and go over each cut properly you will do a neat job without involving much labor which will be required to finish the commutator after the turning process is over. Of course you know when the tool leaves a clean, even surface on the commutator the turning part is done, you will then need to file out the tool marks and finish with sandpaper.

"In filing out the tool marks you should use a medium fine file until all of the tool marks have disappeared. During the process of filing you should use plenty of chalk on the file, as this prevents the copper from filling up the file cuts. Of course you should use the file brush often so as to keep the file clean. This also lessens the labor of filing. Don't make the mistake of trying to file the whole surface of the commutator at once; you must go over the surface evenly, and if you follow out these directions you will accomplish successfully the filing of the commutator.

"After the filing is done you can then finish with sandpaper, first using a medium coarse quality and finishing with a fine grade. Whenever I sandpaper a commutator I always use a block having a curvature to fit the commutator, the sandpaper is placed in the curve and the block is moved up and down the commutator surface until the sandpaper is well worn, when another sheet can be substituted. In this way the sandpapering is brought to a close."

AN AUTOMATIC FAN SWITCH

By C. V. Hull

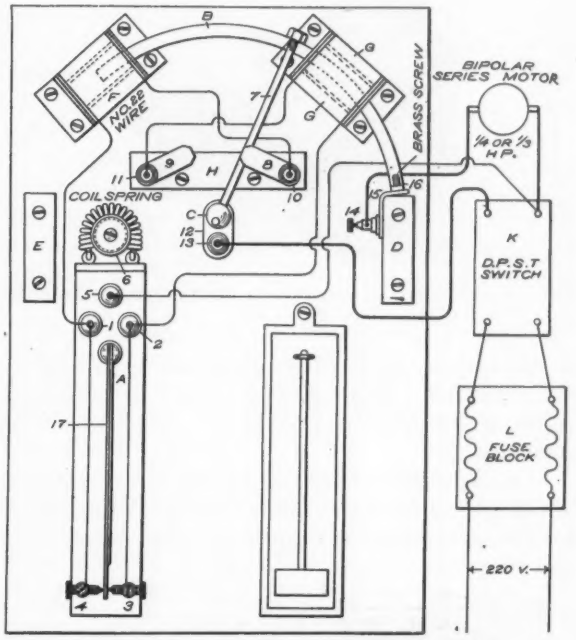
The Hart-Parr Co. is using 10¼-hp. and 9⅓-hp. 220-volt direct-current series motors, direct connected to fans. These fans drive cold air through steam radiators to obtain better distribution and increased capacity. When installed these fans were started and stopped, occasionally, by the nearest workman, but this was so unsatisfactory that a thermostat switch was designed which gave excellent results.

The thermometer and thermostat, shown at A, are of regular construction and are the only parts not made in the shop. The parts of the bar are vulcanized rubber and steel. The thermostat was suspended from a coil spring at 6 because the jar of the walls interfered with close regulation.

A piece of mild steel, ⅜ in. diameter and 12 in. long, was bent as shown, and fastened to an arm, 7, which is 5.25 in. and has a bearing at C. Hard-wood blocks, D and E, serve to limit the travel of B.

At F and G are 2 solenoids which have ¾-in. openings through which B travels. The spools are 1⅞ in. long and 1.75 in. diameter, wound full of No. 22 cotton covered wire.

H is a block of wood with brass strips, 8 and 9,



AUTOMATIC SWITCH FOR CONTROL OF SERIES WOUND FAN MOTORS

held by binding posts 10 and 11, making contact with 7. The bearing, C, moves on a bolt having a shoulder which holds a brass plate, 12, and binding-post 13. A binding-post, 14, holds a brass strip, 15, to make contact with the brass screw in the end of B.

The parts were mounted, as per sketch, in a hard-wood box, which could be bolted in any convenient place with B at the top and swinging in a vertical plane, with a glass panel put in front of the thermometer, as it was advisable to keep the box locked. The box was about 4 by 14 by 18 in. The switch, K, and fuse-block, L, were placed outside the box that the motor might be stopped in case of need without opening the box.

The switch is shown in running position. It will be seen that, as bar 17 bends with rising temperature, it makes contact with post 4 and closes the circuit of spool F which draws B and breaks the motor circuit. As B passes the center, contact is broken at 8 and B

falls on block E. When the temperature falls, bar 17 bends to post 3 and B is drawn to the right, starting the motor.

A range of 5 deg. F. was kept, which was quite close, and the fans did not start so frequently. All regulating is done by screws, 3 and 4, which have platinum points.

TRUING A COMMUTATOR

For holding the file when filing the commutator on a generator or motor a rest may be made consisting of 2 pieces of iron, each provided at one end with an adjustable piece, c, Fig. 1. One of the pieces is attached

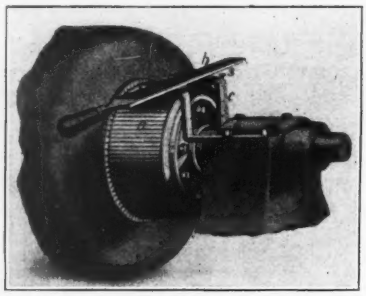


FIG. 1. METHOD OF USING FILE REST TO SMOOTH COMMUTATOR

to each side of the bearing and is held in position by the cap bolts. A file is laid across the adjustable pieces, which are set so that the file will just touch the commutator.

The separate parts of the file rest and the method of assembling are clearly shown in Fig. 2. Slots B are for the reception of the cap bolts. The other end is

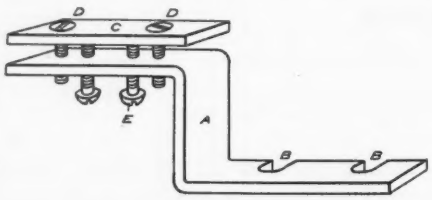


FIG. 2. DETAILS OF FILE REST

provided with an extra piece, C, whose height is regulated by the screws E and held to position by the screws D. The bar A should be of such dimensions that the pressure on the file will not cause it to bend.

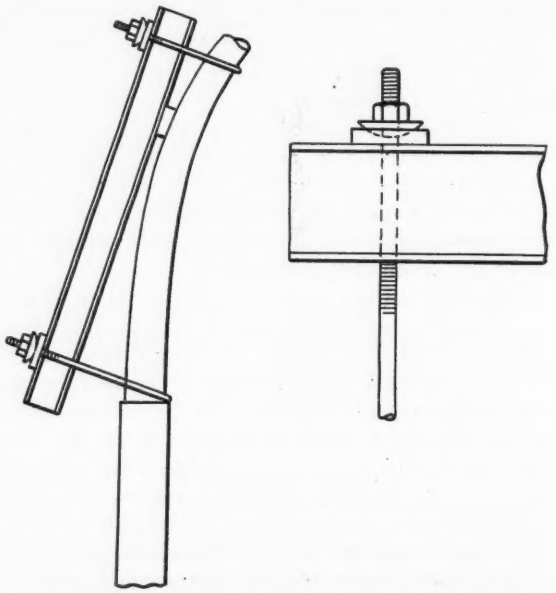
STRAIGHTENING PIPE

A method used in San Francisco after the big fire to straighten iron poles on the trolley lines may frequently be used to good advantage in straightening or in bending large pipes. In the San Francisco case a piece of rail 7 in. high, weight 107 lbs. to the foot, and 10 ft. long was used as the lever, a wooden fulcrum block being placed between the rail and pole, at various points as needed. One end of the rail was hooked short to the pole by a U bolt and nuts, and long U bolts were used on the other end of the lever to pull the bent section back into position.

In order to prevent jamming of the bolt threads, hemispherical washers were put in countersinks in the cross bars under the nuts and with plenty of lubricating oil the threads on the U bolt legs were kept from injury. The success was due to the fact that all the deflection in the poles was not due to a bend at one point and the unbending could be accomplished by taking prys all along the length of the pole.

A NEW TYPE OF ELECTRIC LOCOMOTIVE

Experiments are now being made by the General Electric Co. and the American Locomotive Co. on a new type of locomotive, which will have the motors mounted on top of the frame of the machine and connected to the



DEVICE FOR STAIGHTENING PIPE AND DETAIL OF BOLT END AND WASHER

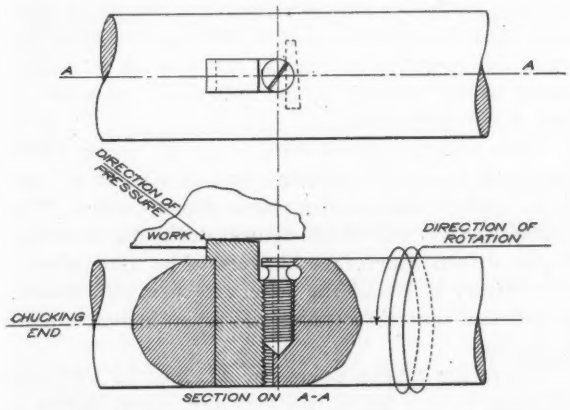
drive wheel by connecting rods. The drive wheels which will be 4, 6 or 8 in number will be connected by slide rods, the same as in the ordinary steam locomotive. This puts the motors where they can be readily got at for repairs, will be kept away from the dust and dirt of the roadbed and can be arranged so as to bring the weight near the center of the locomotive, allowing the leading and trailing wheels to run lighter and thus avoid wear on the flanges and rail heads. The motors may be arranged as direct or alternating current, but on the present locomotives, they are started as repulsion motors, with short circuited armatures and are changed over to series motors for higher speed. They run on alternating current at high voltage.

AIR PUMPS FOR CONDENSERS should have a piston displacement, that is piston area times stroke, equal to 1/75 that of the low-pressure cylinder of the engine served.

AN ADJUSTABLE BORING BAR

IN designing the arrangement shown in the illustration the object was to reduce the number of cutters that we had been obliged to carry in our tool room; we wanted to be able to bore several sizes with one cutter. Still another reason was, that we wanted to bore a given hole for any kind of fit required; sometimes a running fit, sometimes a forced fit, or a shrink fit, and we wanted to do it all with the same cutter.

A tool steel cutter was made, about ⅜ in. or so, longer than the diameter of the bar, which was 2 in. On the back of this cutter, a lug was left, about 1⅝ in. long, which was drilled and tapped out, for a set screw ⅜ in. diameter; then about 3-5 of the lug was cut away, leaving a concave, threaded projection. The bottom of these threads, however, is not quite in line with the back of the cutter, and this difference is the amount of clearance for the head of the screw. This clearance should be as little as possible, for grit and



ADJUSTABLE BORING BAR FOR USE ON A LATHE

dirt will settle there. The width of this cutter was 1 in. exclusive of projections, but the width should be governed by the kind of work you propose to do, and the thickness of the cutter; you will do well to make it the same as the diameter of the set screw.

The hole for the set screw was located about the center of the bar, lengthwise, and a ⅜ in. reamed hole put down about 1.5 in. By placing the cutter on the bar, and placing the concave, threaded projection in line with the circumference of the reamed hole, the cutter, of course, standing on end, cutting end up, and the long sides parallel with the center line of the bar, the size for the slot may be marked off. Then the slot should be drilled in, as far as possible; that is, as many holes drilled as possible, and the slot then either filed out or worked out on the slotter.

When I say the concave projection should be placed in line with the circumference of the hole I mean, of course, the bottoms of the threads; the threads must be in the hole, and, besides, you could not line up the tops of the threads with the hole. Any suitable set screw with a head such that it will clear the threaded lug may be used, and its length may be judged from the sketch, as may also, its position. A standard taper pin must be put through, just under the head of the set screw as shown, to prevent the screw working loose in action, and also to keep the screw in its proper place. This pin is to be loosened to set the cutter, and tightened up again when the cutter is set.

"Chips" P. S.

QUESTIONS USED AT THE FEBRUARY, 1909, EXAMINATION OF HOISTING ENGINEERS IN ILLINOIS

1. What are the laws in regard to the duties of a hoisting engineer?

2. What are the laws in reference to persons going into the engine house?

3. What are the laws in reference to care of engines and boilers?

4. What is the law in reference to signals? Give signals.

5. What is an indicated horsepower? Give data.

6. We are using 1,200 lb. of coal in 8 hr. to do our hoisting, pumping and running our fan. We are putting water into the boiler at 45 deg. F. How much coal would we use, if we put in feed water at 100 deg. F.?

7. How would you prepare a boiler for cleaning?

8. We have a tank full of water. It is 10 ft. in diameter at the top, 12 ft. in diameter at the bottom and 12 ft. high. We use 234 hp. How long will it take to empty the tank?

9. A boiler is allowed 150 lb. pressure per sq. in. with thickness of steel 0.045 in., tensile strength of steel 60,000 lb. a sq. in. What thickness should a 22-in. pipe be to stand the same pressure, tensile strength of steel being the same?

10. A boiler to give 100 hp. is to be 72 in. in diameter and 16 ft. long. Give size and number of tubes; heating surface; square feet of grate surface, and kind and size of safety valve.

11. We have a pair of compound engines working under 150 lb. steam pressure. The high-pressure cylinder is 18 by 20 in. What size should the low-pressure cylinder be?

12. A circular tank 10 ft. in diameter at the top, 12 ft. in diameter at bottom and 12 ft. high. How much coal would it take to evaporate it into steam at atmospheric pressure?

13. A cylinder of boiler steel is 48 in. in diameter and 18 ft. long and 0.045 in. thick. What is its weight?

14. A shaft is 300 ft. deep; it is 50 ft. from ground to dump. How many revolutions would a drum 6 ft. in diameter make in hoisting a cage of men according to the state law?

For answers to questions 1, 2 and 3 see Practical Engineer, October, 1908, p. 48, last column.

The best set of answers to the other 10 questions will be published and paid for.—Editor.

TO HAVE WHAT WE WANT is riches, but to be able to do without is power.—Geo. Macdonald.

LETTERS FROM ENGINEERS

Send us descriptions of ways of doing new things, and new ways of doing old things. Rough pencil sketches and letters are all right; we will fix them up for the printer. All accepted contributions will be paid for when published.

Steamship Equipment

I have been a reader of Practical Engineer for 2 yr. and have always found it interesting and also profitable reading, even unto the advertisements. Although I am not an engineer in charge of a plant I have my share of the upkeep and operation to look after. I think that it might be of interest to the brother engineers to know something about the machinery that is used in the navy.

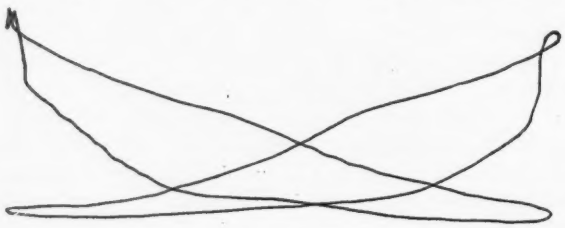


FIG. 1

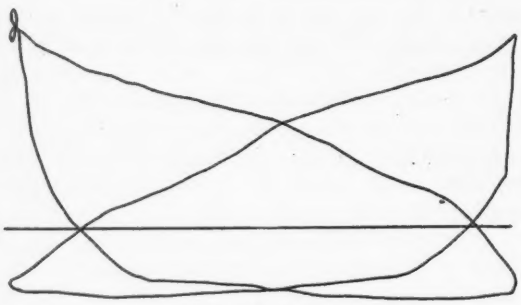


FIG. 2

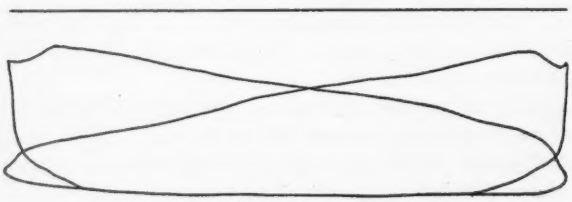


FIG. 3

FIG. 1. HIGH-PRESSURE CARD. BOILER PRESSURE 155 LBS. RECEIVER PRESSURE 95 LBS. 60-LB. SPRING LINK 0.5 FULL GEAR

FIG. 2. INTERMEDIATE CARD. 2ND RECEIVER 40 LBS. 40-LB. SPRING

FIG. 3. LOW-PRESSURE CARD. 3RD RECEIVER 12 LBS. VACUUM 25.5 INS. 20-LB. SPRING

In the boiler rooms of this ship the equipment consists of 24 Niclausse water-tube boilers rated at 760 hp. each, hand fired, and each has 64 sq. ft. of grate surface. The feed water is supplied by pumps and there are 2 independent feed inlets for each boiler, a main feed and an auxiliary.

Steam in leaving the boiler passes through a manifold which contains an automatic stop valve which closes all steam outlets except to the safety valve. The automatic stop is supposed to close itself by the back rush of steam from the other boilers in case a tube bursts. There is a small steam line that leads to the automatic valve with a control valve in another fireroom so that in case the automatic refuses to close itself all that is necessary is to step into the next fireroom and open the emergency valve which will admit steam to the cylinder of the automatic valve and in that way force it shut.

Each boiler is fitted with a 3.5 in. spring safety valve set at 255 lb. pressure and is also fitted with both bottom and surface blow down valves. The boilers are worked under natural draft, but there are engine driven Sturtevant blowers to be used when it is necessary to crowd the boilers to their full capacity as becomes necessary sometimes when maneuvers are going on.

There are 8 feed pumps in all, four 12 by 12 in. and four 9 by 5 by 12 in.; they are Snow pumps, of the vertical, duplex, outside center, packed plunger type.

The ship is driven by twin engines rated at 16,000 hp., each engine in a separate compartment and with its own auxiliaries. The engines are of the vertical, inverted, 3-cylinder, triple-expansion type, and have the Stephenson valve gear. There is a surface condenser for each engine with independent air and circulating pumps; also an auxiliary condenser in each engine room; also for fire and bilge pumps, and the circulating pumps for the distillers.

The evaporator plant contains 4 evaporators of 5000 gal. capacity, each for 24 hr. There is also a small machine shop for making such repairs as can be made aboard ship. Enclosed you will find a set of cards that were taken on this run.

I. P. Farnsworth.

Threading Large Pipes

Where no big pipe threading machine is used and the thread is cut on the lathe, regular tapers cannot be given and it is only by steps that the cut is made so that the pipes are liable to leak, the whole pipe holding on only 2 or 3 threads. Herewith is shown a drawing of an attachment which I have used success-

fully. This can be used on any lathe and any taper, as well for boring as for thread cutting.

Fig. 1 shows the cross section of the lathe bed looking at it endwise and Fig. 2 a top view of the lathe bed and attachment. From a stud in the tool post holder a plate, 1, runs to the follower 4. 2 is the taper set plate made so that the follower 4 will slide on it and be held in position by the dove-tailed base. This

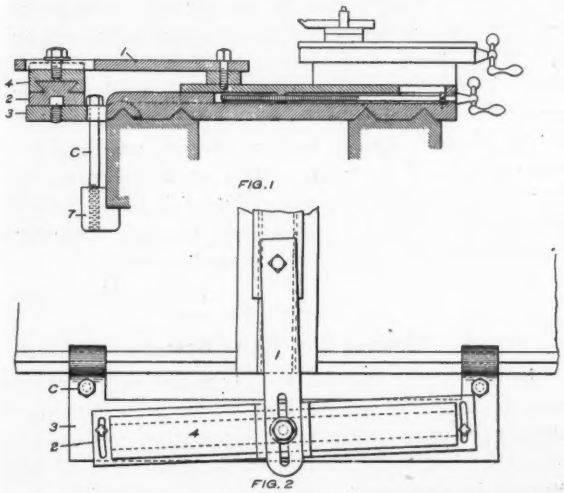


FIG. 1. SECTION AND TOP VIEW OF PIPE THREADING ATTACHMENT TO LATHE
FIG. 2. DETAILS OF PIPE THREADING ATTACHMENT

base can be turned about a center post to give any taper, and fixed at each end by 0.5-in. set screws.

The base 3 slides along on the v rails of the lathe bed and is fastened in position by bolts C and shoes 7.

Suppose now that a taper thread is to be cut on a pipe, loosen the big set screw which carries the tool holder so the slide will be controlled by the plate 1.

The swinging bed 2 is set to the required angle and the bolts fastened at C. The yoke 1 is then connected at the correct length to the tool post slide of the carriage, and to the slide 4, making both bolts tight, and all is ready to start the cut. After the angle is once set, the regular feed of the lathe can be used, and an emery wheel attachment can be mounted so as to grind any piece, straight or taper. When the attachment is not in use, loosen both of the bolts C and keep tight only one screw on the connection plate 1.

Charles Labbe.

Pump Lift 28 Feet?

I have a proposition that I should very much like to see discussed in the columns of Practical Engineer. I have charge of a compound noncondensing piston-pattern pump; steam cylinders 8 and 12 by 14 by 12 in., connected to a 16-in. cast-iron suction pipe, which is reduced to 12 in. at the pump.

This main is in turn, connected to 16 3-in., 2 5-in. and 1 2-in. wells, which are about 40 ft. deep, and are supplied by a bed of water bearing gravel. The pump is without a vacuum chamber on the suction, and has run almost continuously night and day, for about 5 yr. without ever having been laid up for repairs. A vacuum gage on the suction has at times shown a lift of 28 ft.

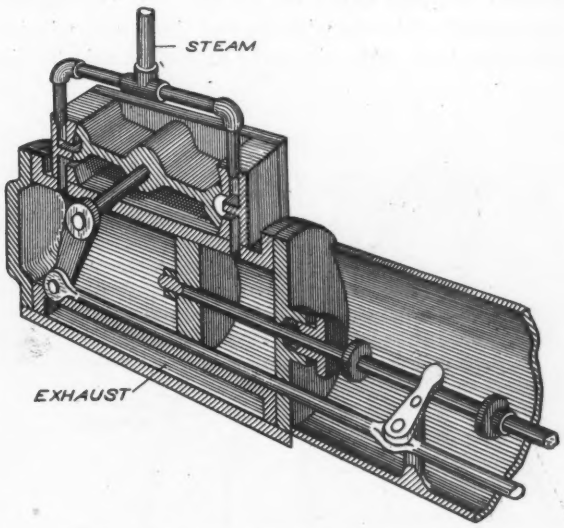
The question in my mind is this: Is the pump lifting the water 28 ft. as shown by the gage? As far as I am concerned, I doubt it very much, and would like to know what some of the rest of Practical Engineer's very large family think about it. F. W.

A Novel Pump Valve

Here is an idea which is a curiosity.

There are 2 steam chests, one at each end on the top of the cylinder and a steam valve working on trunnions between them.

This valve is in full sight so if it leaks you can al-



NOVEL PROPOSED STEAM VALVE FOR PUMP

ways see it. It contains a steam passage at each end on about the same principle as a slide valve.

The 2 steam chests are bolted to the cylinder and can be moved up against the valve to take up lost motion. G. G.

Connecting Rod Brasses; Cylinder Wear

A whole lot of trouble was caused by a man who was in too much hurry or who did not know what he was doing when changing some old brasses and putting in new ones. The engine in question was an old one, with solid end connecting rod, and the piston rod was attached to the crosshead by a taper fit and drawing key, the piston was attached to the rod by a taper fit and a small drawing key and the end of the rod headed over.

The connecting rod brasses were heated a good many times and were a great deal smaller than when first run, so that all the take up on the wedge was used and a shim with it, and the engineer asked the superintendent for new brasses. Finally the superin-

tendent consented to have a new set of brasses for the crank end and also for the wrist pin end. The size of the opening in both ends of the rod was taken on cardboard and a pattern made for each half, but no attention was paid at all to clearance.

The plant was busy and all fitting had to be done on Sunday, but when the brasses came Mr. Engineer put them in and took the old ones to the foundry as old brass without trying his clearance.

When the engine was started the brasses on the outer ends of the rod were too large, thereby shortening the rod so that when the crank end was reached the piston came up hard against the end of the cylinder causing a heavy pound and jarring everything in the place. After a while the crank pin brasses got hot and no amount of oil could cool them, so the engine was shut down and the superintendent sent over to where I was and asked me to look over the engine. The engineer told me what he had done, and when I asked him how much clearance he had he said he did

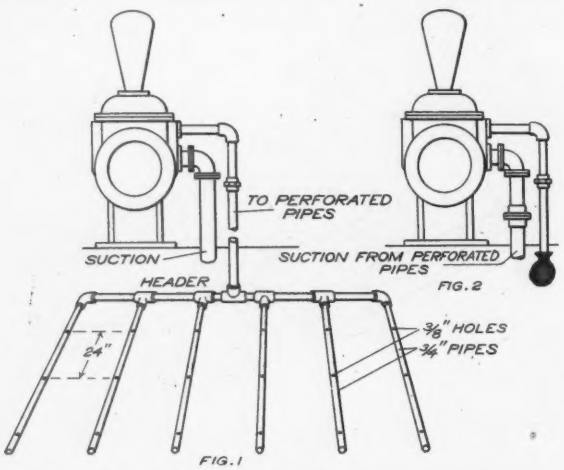


FIG. 1. BRINE DISTRIBUTING SYSTEM AND REGULAR CONNECTION

FIG. 2. TEMPORARY CONNECTION FOR CLEANING PIPE

not know. I asked him if he knew where the striking points for each end were and he had never tried to find out in 16 yr. at the plant, so I found them by taking out the wrist pin and pushing the piston to each end of the cylinder and putting a straight edge at the face of the crosshead on to the frame and making a mark.

I then took the piston out of the cylinder and found it was started on its fit, and next I had the key driven out and I made a careful examination of the end of the rod at the key way for a fracture. As no fracture appeared I had the key driven again and brought the piston up to where it was originally. After taking 0.25 in. off the outside half of the crank brass it was put in place and everything was keyed up. The engine was then turned over, which proved it to be all right.

I then placed it on each center and found how much clearance there was on each end. The head end had 5/16 in. while the crank end had 3/16 in., but the take up on such rods increases the clearance on the crank end and decreases the clearance on the head end so I left it for good enough, and it has been doing duty ever since without any trouble.

Some 20 yr. ago, when I first started in the business, I had a 28 by 48 in. engine, running 100 r. p. m. and doing nearly 600 hp. It started to wear the cylinder on the top side and I tried it for line which proved to be true. I used a good oil and lots of it, but it continued to get worse. I had the cylinder bored out and new rings made, and after a while it was as bad as ever, so that the superintendent would not bore it any more. He got a new cylinder from the engine builders of the same design to replace the old one, and it is running yet. I am using only 1 qt. of oil in 10.5 hr. and it is as clear as a mirror. The fault is often due to the castings being too soft, as was the case with mine, I could take the scraper and scrape a hole in it.

M. J. C.

Clearing the Brine System

In the early part of this summer, while repairs were going on in an ice factory, we were putting in some new cans and a brine circulating system in a tank that had to be built up a little so as to be high enough for the cans.

In doing this work there were some little pieces of shavings dropped in the tank, all of which were not gotten out, and caused trouble in our brine circulating system. The way we arranged for complete distribution of brine was that, under every third freezing coil, there was a ¾-in. perforated pipe, with ⅜-in. holes 24 in. apart, connected to a header into which the pump discharged. These little shavings that were left in the tank would pass through the pump all right, but would not go through the holes in the pipe.

After a few days' running all of these holes were stopped up and the pump would not run.

It looked for a few minutes as if we would have to cut out the tank and let the temperature go up enough for us to get in and take out the pipes and clean them out; but the chief happened to think of a better plan which proved successful.

We connected the suction pipe to the manifold that had been the discharge and discharged into the tank. Around the end of the discharge pipe was tied some common screen wire which caught all the shavings.

After running this way for several hours, we connected up the right way and it has given no trouble since.

A. C.

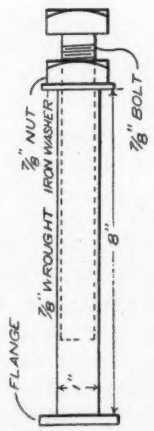
Pounding Engine

On page 381, June issue of Practical Engineer, Wm. Westerfield writes "why does the engine pound." An engine can pound from a good many causes, but there was a pound that gave a whole lot of trouble to a young engineer friend of mine. The young man in question had great confidence in himself and had done about everything he could think of to stop the

pound, had keyed up the brasses in the connecting rod and also taken up on the slide shoes of the crosshead so that everything was running at a high temperature bordering on heating and no good.

So one evening when I was leaving the lodge room where he was a member also, he called me and told me his troubles and asked me if I could suggest some remedy which would stop it. I told him it would be mere guess work for me just then to say where the pound was or what caused it; but if it was agreeable to him, I would find time next day to go and see him and also his engine that was causing him such trouble.

And when I did go to the engine room there was a sharp pound and after looking over everything that I could think of that would cause a pound I told him it must be that the brasses had too much end play in the cross head, which was of the box pattern, and that it would be easy to see it when the engine was shut down. So at noon when it was shut down I went over again and sure enough there was 1/32 in. play and as the foundation was poor and the engine frame light it aggravated the trouble more than if the conditions were good.



HOMEMADE JACK SCREW

I suggested that he get a ring a little larger than the wrist pin and put it in or get 2 halves and sweat them on the ends of the brasses and dress to the size of the ways in the crosshead. When done I promised him the pound would give him no more trouble as long as the ring remained or the pieces stayed in place.

He did as I told him and surprised himself. Young engineers should not be ashamed to ask and should ask men who are willing to tell them. I would advise young men to mingle with men in the business and get an exchange of ideas and also read Practical Engineer, and by doing so they will broaden the mind and make better men, better able to explain troubles than if they depended on themselves entirely. M. J. C.

A Homemade Jack Screw

I take a great interest in your department letters from engineers, in Practical Engineer, and am sending a plan for a small jack which is cheap, simple and quite useful in the shop. All that is required is a bolt ⅞ by 8 in., 1 washer, a piece of 1 in. pipe 8 in. long and half of a 1-in. pipe flange. It is astonishing how much this little jack is capable of raising. It does not require over 10 min. to make it. Geo. E. Lansing, Jr.

Valve Adjustment Needed

I am sending you two indicator diagrams from the low pressure cylinder of an 18″x32″x42″ E. P. Allis Corliss engine.

The condenser lost one of the discharge valves and as the condenser was being repaired I took card No. 1 while exhausting to atmosphere. The engine ran very quietly, making 78 r. p. m. The expansion line drops down to the atmosphere line and, after the return stroke is commenced, it rises about 2 lb. above it.

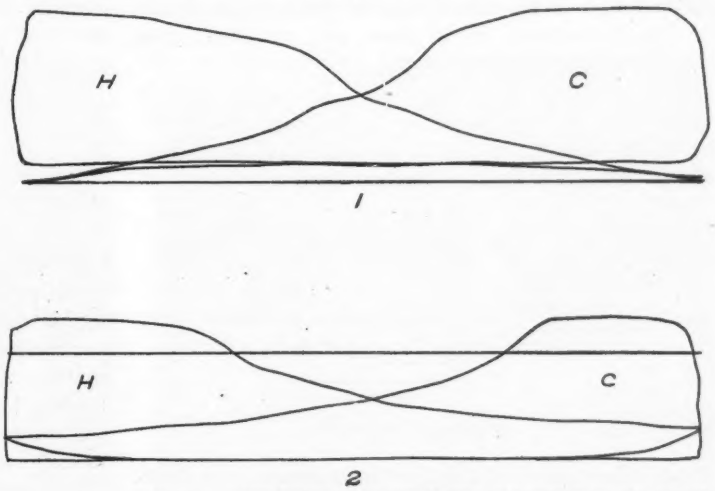


FIG. 1. CARD FROM LOW-PRESSURE CYLINDER 32 BY 42 IN. OF CORLISS ENGINE. RECEIVER PRESSURE 15 LB. 16 LB. SPRING. NO CONDENSER.

FIG. 2. CARD FROM LOW-PRESSURE CYLINDER WITH CONDENSER ON. RECEIVER PRESSURE 4 LB. 16 LB. SPRING. VACUUM 25 IN.

No. 2 was taken after the condenser was started again. The eccentric follows the crank on this cylinder.

My opinion is that, if I move the eccentric back a little, all operations will be a trifle earlier and consequently will give me earlier admission, which will straighten the admission line on both ends and also give an earlier exhaust with more compression. I would like to hear from other readers.

Edw. A. Freeman.

Diagram Discussion

In complying with the request of J. U. Varden I would say that in my opinion the valve opening seems to be restricted; judging from the drop in the steam line the steam is not following the piston fast enough to keep the pressure up to that at the beginning of the stroke.

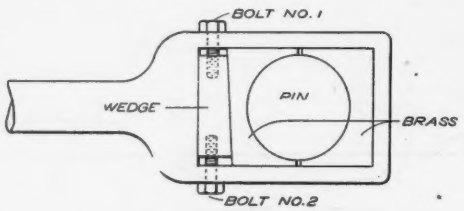
The offset on the compression line would seem to indicate that steam was escaping from the compression space by a leak through the exhaust valve on the head end. It occurs to me that the sudden drop in pressure at the beginning of the stroke at the head end is due to the exhaust valve being late in closing, thus allowing live steam to blow through. The pressure thus weakened in the head end working against such an excessive back pressure as 100 lb. tends to lessen materially the amount of work done in that end of the cylinder. I do not say that this is correct, but merely my opinion of the matter.

Le Roy Scott.

Broken Wedge Bolts; Loose Piston

In a power house were 2 450-hp. high-speed automatic engines running at 150 r. p. m., direct connected to 300-kw. d. c. 250-volt compound-wound generators.

The lost motion in the crank and crosshead pins was taken up by wedges being raised by means of 1 bolt in the top of the wedge and 1 in bottom, pulling opposite each other, as shown in the diagram. These bolts were about 1⅛ in. and screwed into the wedge. We have had the heads of a great many of these bolts



CROSSHEAD BRASSES

break off while the engines were running. The bolts appeared to have been made of steel and had hardened and had become white. None of them broke under light load but all broke under about full load and would not give any warning at all. Any engineer can guess what the noise was like when the bolt would lose its head, letting the wedge drop down and thus letting the brasses loose.

The top bolts broke more often but the bottom ones have done so. Sometimes the head would fly off a bolt and again the bolt would break 1.5 or 2 in. from the head.

These engines are internally oiled, with a small clearance in the crank pit under the crank. One night a head flew off of a wedge bolt and went in the small space under crank in the pit and as a result the crank acting as a sledge drove the bolt head through the casting, which was not very thick, and let all the oil out before the engine could be stopped. A copper patch 0.25 in. thick was put on the bottom of the pit with ⅜-in. cap screws and the engine has been running almost a year since it was patched. It leaks a small amount but not enough to cause much trouble, and was cheaper than a new casting which would have caused an expensive delay. Can anybody explain why the wedge bolts break?

An erecting man was sent out by a large engine works to overhaul some new engines. They were 24 by 24 in., 150 r. p. m., automatic engines and had been run but little, as the first erecting man had failed completely to get an acceptance of the engines in any way. So the engine works sent out the second man.

He found the pistons loose in both engines, there being 2 of them, and he did not know how the pistons were fastened on the rods so he had to telephone the engine works to find out. It was found their rods had been turned for a pressure fit, that is, the rod was left tight and forced into the piston head with several tons pressure. It must have been that the machinist in the factory who did the lathe work was somewhat careless in fitting the rod and head, thus causing a loose piston almost as soon as the engine was started.

The erecting man succeeded in peening and expanding the end of the rod until he made the piston last long enough to have a new one sent from the factory. The condition was the same in both engines.

O. L. H.

Gas Engine Sparker

One day I was called to see what was the trouble with a 32-hp. gasoline engine which refused to start. The man in charge told me that the engine ran all right for 3 weeks past and that morning refused to go.

I took down the feed pump and that was all right. The feeding was good, compression was all right too, and the spark and exhaust head right. I then took the sparker apart; there was no insulator broken and nothing looking wrong. I cleaned the platinum point and tried the spark and it was looking strong enough when I moved the hammer with my finger, so I said, "Let's try again"; but the engine refused again to start, and I tried once more, helping the hammer of the sparker so that it would jump quicker, and then the engine started. The spring was not strong enough, although I thought that the spark jumped; I put a different spring on and everything went along all right.

Charles Labbe.

Hammering in Water System

We have a water system here in which they pump the water into the mains with a 5.5 by 6-in. duplex power pump, 100 ft. from the standpipe, under 45 lb. pressure. There was a check between the pump and the main, and the hammering at the hydrants was very annoying. I had them take out the check which stopped the trouble, but the pressure stands on the pump. Can any of the readers tell me how to stop it? J. H. J.

WHEN DRY CELLS ARE RUN DOWN, a method of prolonging their life is to make a hole through the tar mixture in the top of the cell and after being sure that it is well down into the cell pour in a solution of strong salt in water with ¼ as much vinegar added. As much of this solution should be poured in as the powder in the cell will take up.

A NEW VERTICAL WATER-TUBE BOILER

While water-tube boilers have been made of numerous different constructions, in horizontal, vertical and inclined types, there are features of the Erie City boiler which give it a unique position in the field. Several cardinal principles have been kept firmly in mind in the design; to make all the heating surface active; to give ample room for the circulation of water up and down; to get plenty of surface for the disengaging of steam, and to arrange a boiler which can be kept clean both internally and externally.

The illustrations shown herewith indicate the general features of construction. The boiler proper consists of 2 drums, 1 at the top and 1 at the bottom, connected by 3 banks of tubes, each tube being bent so that it enters both drums at right angles to the surfaces of the shells. The entire structure is hung by

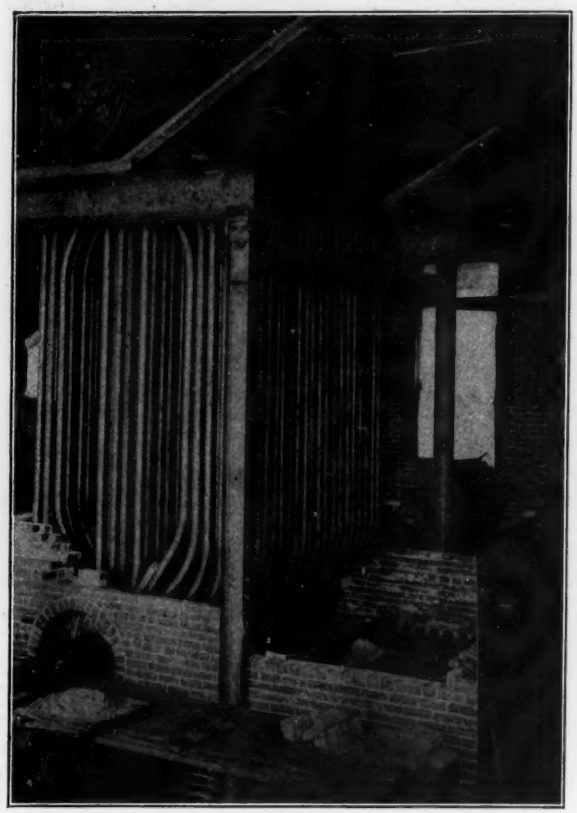


FIG. 1. ERIE CITY VERTICAL BOILER AND FURNACE UNDER CONSTRUCTION

means of saddles under the ends of the top drum, these saddles resting on I beam supports, as shown in Fig. 1.

The furnace is of the Dutch oven type located in front of the boiler proper and may be arranged with any kind of a grate or stoker as desired.

The first pass of the gases is upward through the front bank of tubes, the combustion chamber being large enough so that combustion is completed before the hot gases strike the tubes. The second pass is downward along the center line of tubes, the third pass upward along the rear bank. Circulation of water is, therefore, up through the front bank and part of the middle bank of tubes, and down through part of the middle bank and the rear bank.

The lower drum is of large size so that it catches all the sediment and scale-forming material and is away from the intense heat of the fire, so that this scale does not become baked hard. The heads of the drums are dished to give great strength without bracing, and designed for a constant working pressure of 150 lb.

In the upper drum partitions are put in just outside the banks of tubes, leaving a space at each end of the upper drum which contains no water and is filled with steam to act as a sort of steam dry chamber from which the steam is drawn; separators may be used on the ends of the steam pipe if desired. The

FIG. 2. FRONT VIEW OF ERIE CITY VERTICAL BOILER

lower drum is not imbedded in brick work, so that the boiler is free to come and go with expansion and contraction without hindrance. The only openings into the boiler are the manholes in the ends of the heads.

As the rising of water in the front bank of tubes extends the whole length of the upper drum, it gives a large free surface for the liberation of steam and the steam chambers at the ends prevent the throwing of water up into the steam pipe when the boiler is working hard. By the design and method of construction all braces and baffles in the drums are avoided, also all flat surfaces or short nipples. The weight of the lower drum and of the water contained is carried on the ends of the tubes and it is found that even without any beading of these ends there is sufficient holding

power on account of the curved form of the tubes to sustain the drum and its contained water.

The steam spaces at the ends of the upper drum give a large steam storage capacity and the large upper drum gives a large water capacity. The 3-pass design insures efficient removal of heat from the gases before they go to the stack and the large front furnace and combustion chamber give insurance of complete combustion. In the rear of the setting a large dust chamber is provided to catch the fine dust and ash that may be carried over from the furnace.

The simplicity of the construction will appeal to

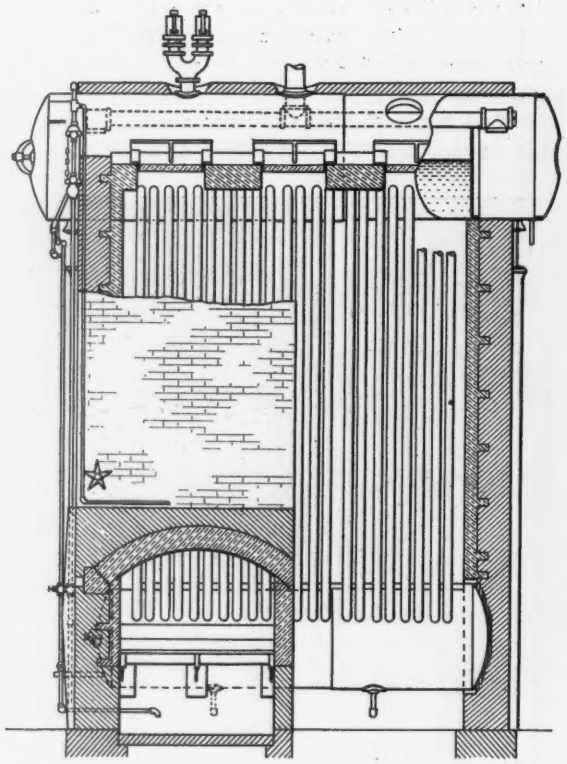


FIG. 3. SECTIONAL ELEVATION SHOWING CONSTRUCTION OF ERIE CITY VERTICAL BOILER AND SETTING

engineers and the generous proportions of heating surface make good economy certain.

Large cleaning-out doors are provided in the sides and rear of the setting so that the heating surfaces of the tubes and drums may be blown off rapidly, and peek holes are provided to give a chance to watch the fire. The form of setting adopted is convenient where change in fuel is desired, as the furnace can easily be changed to give more or less grate area and combustion chamber volume, as may be desired for different kinds of coal. The upper drum is large enough so that a man can easily work inside it and the manholes are large enough so that one can easily enter to inspect and clean the tubes. Water is fed into the lower drum.

The boiler is constructed either with brick setting or with a steel casing, as may be desired. The steel casing is, however, recommended, as in using this no red brick is necessary and a lining of 9-in. firebrick throughout is all that is required. The steel casing absolutely prevents leakage of air into the setting and can be made as tight as the boiler itself.

The boiler shown in the illustrations has an upper drum 48 in. diameter, lower drum 40 in., and 11 rows of 3-in. tubes running from top to bottom, 22 tubes to a row. This gives altogether 2,377 sq. ft. of water heating surface and a travel of the gases of about 40 ft. over the heating surface. In trials recently made, the boiler, which was rated at 238 hp., developed over 500 hp. and burned 36.7 lb. of coal per sq. ft. of grate.

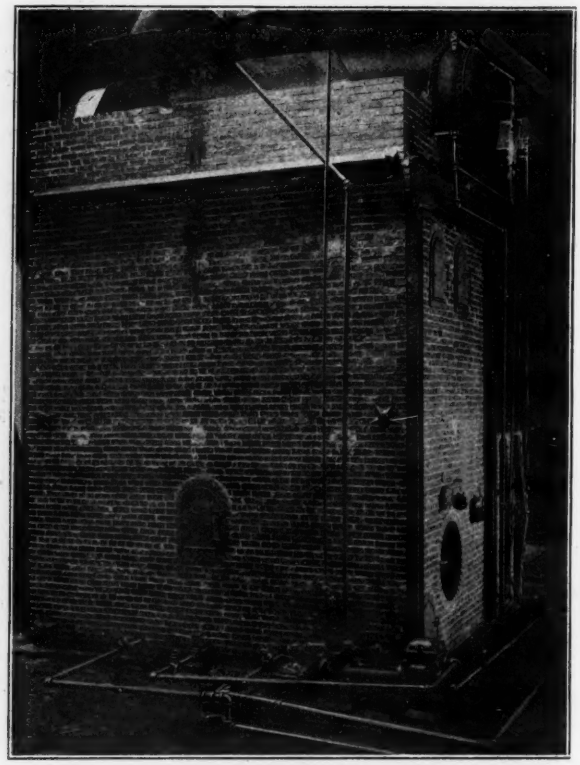


FIG. 4. ERIE CITY VERTICAL BOILER FROM REAR OF SETTING

The tubes are so arranged that any one may be cut out and removed from the boiler without interfering with any other tube or disturbing the drums. Shells are constructed of open hearth steel plate with a tensile strength of 60,000 lb., the edges being bevel planed for calking, with circumferential seams single riveted and longitudinal seams triple riveted with double butt straps.

This boiler is an additional evidence of the progressive spirit and up-to-date methods of design and construction adopted by the Erie City Iron Works, of Erie, Pa., in its products.

THE INTERESTS OF THE DIESEL ENGINE CO. in the United States have been bought by Adolphus Busch, of St. Louis, who will organize a company in the near future to carry on the business, but in the meantime is conducting business in his own name in the South Side Bank Building, St. Louis, Mo.

THE COMPENSARC

The need of some kind of a device for controlling arc lamps on moving picture machines is obvious when it is known that moving picture machine arc lamps operate at approximately 35 volts at the arc, while the voltage obtainable from practically all commercial lighting circuits is either 110 or 220 volts. Some electrical device must of necessity, therefore, be used between the line and the lamp to take care of the difference in voltage. Formerly iron-wire or grid resistance rheostats were used, but their use resulted in a waste of all the energy supplied from the line over and above that actually required by the lamp. Progressive managers are now using Compensarcs instead of rheostats to operate their arc lamps from alternating current circuits.

The Compensarc cannot be used on direct-current circuits. It is in reality a special type of adjustable, autotransformer.

This Compensarc is known as Type A, Form 4, and is rated at 2 kw. for 110 volts or 2.5 kw. for 220 volts and wound for either 60 or 133 cycles, as may be desired.

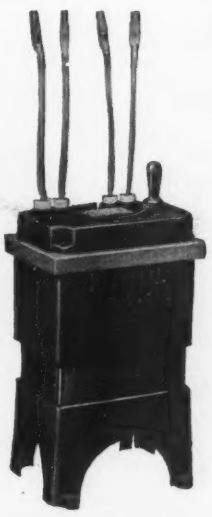
The general appearance of the Compensarc is clearly shown in the illustration. The core is made of the highest grade sheet steel laminations, similar to standard transformer construction. The outer surface of the core is fully exposed to the air, while the coils are mounted within the core and are completely protected and thoroughly insulated. Core and coils are given vacuum treatment, making them moisture and water proof.

Assembled core and coils are supported by a cast-iron base having 4 legs which hold the Compensarc at a convenient height from the floor. The case, which is also of cast iron, rests on the top of the core, is liberally ventilated and encloses the ends of the coils and protects the connections on the inside. The slate top supports the switch blade and clips. The slate top, case and base are securely held together by 4 long heavy bolts, one passing through each corner of the slate top, case and base outside the core.

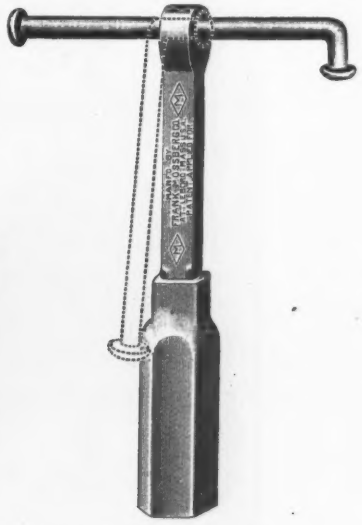
A horizontal, 3-step, continuous circuit switch is mounted on the slate top, providing 3 adjustments for intensity of light, each adjustment being so designed that it maintains approximately the same voltage at the arc while passing from one step to the next, without at any time opening the circuit. There is no waiting for the arc to settle and become steady before the intensity of the light can be determined, as the Compensarc increases or decreases the intensity of light without a flicker. A cast-iron cover over the slate top completely encloses the switch blade and contacts, making it impossible for accidental short circuits to occur, and also removes all danger to the operator.

Terminals to the line and lamp are brought out through porcelain insulators in the cover, the lamp terminals being plainly designated by the word "LAMP" cast on the cover where the terminals come through, so that with a little care, the Compensarc can be installed by any operator. It is extremely simple to operate; one hand on the switch handle controls everything.

Even though the switch blade is at an intermediate point, thus bridging 2 adjacent contacts, it will not burn out. These adjustments are essential to successful moving picture work and the fact that the Compensarc provides them without breaking the circuit and putting out the light makes it all the more desirable.



THE COMPENSARC AS INSTALLED



THE MOSSBERG SOCKET WRENCH

The Compensarc saves 66 2/5 per cent on light bills for moving picture arc lamps, and provides a clear, white, steady light.

It is approved by the National Board of Fire Underwriters, as there is positively no fire risk, and no noticeable rise in temperature even after several pictures have been run through the machine.

It is made by the Fort Wayne Electric Works of Fort Wayne, Ind.

MOSSBERG SOCKET WRENCH

Herewith is illustrated a convenient wrench for motor boats, gas engine pumps and other light machinery to be used in places where the nuts are difficult of access. It is sufficiently heavy to take care of nuts up to 1.25 in. in diameter and has sockets for hexagonal nuts, from 5/16 to 1 9/32 in., and for square sizes 13/32, 15/32 and 21/32. When not in use, the handle can be folded down as shown by the dotted line, so as to lie flat with the body, thus requiring but little room in the tool box.

SQUIRREL-CAGE INDUCTION MOTORS, with full applied voltage at the terminals, give a starting torque of about 1.8 times full-load torque, with about 6 times full-load current, or, for full-load torque, the starting current is about 4.5 times full-load current.

THE AMERICAN BOILER FLUE CLEANER

In this device, which is designed to reduce fuel consumption, lessen labor and prolong the life of the boiler, steam jets are so arranged in 3 sections that they may be blown through the tubes without letting down the boiler pressure, opening the doors or in any way interfering with the operation of the boiler. It is designed by the makers as a permanent attachment to the boiler, will work by the turning of a valve and in 5 min. will blow the fire tubes of any horizontal or Scotch marine boiler free from soot and ash.

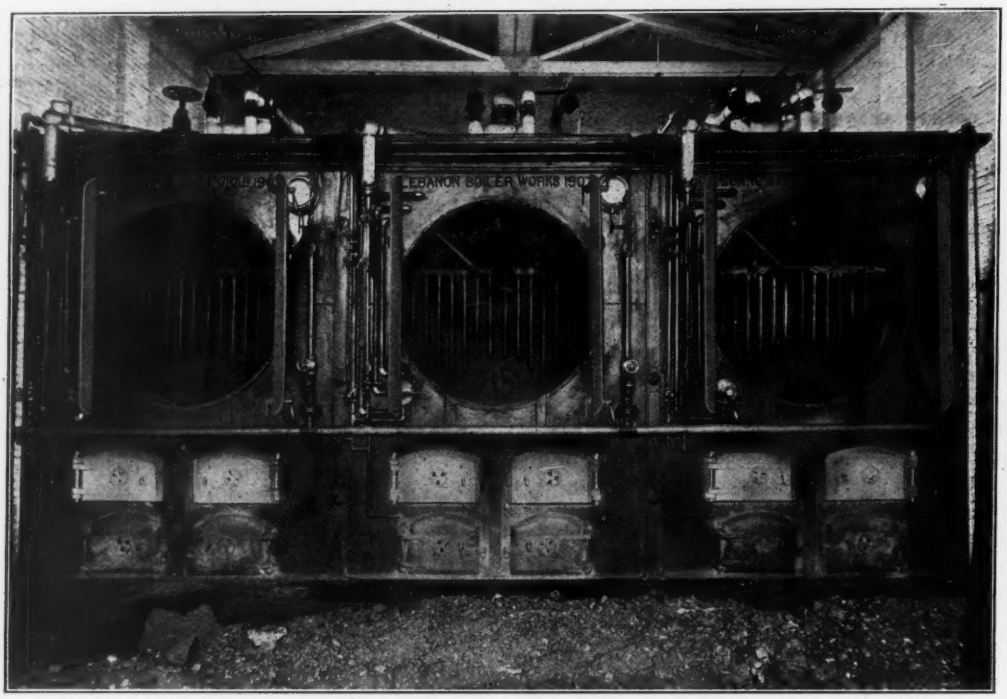


FIG. 1. AMERICAN FLUE BLOWER ATTACHED TO BOILERS

Figure 1 shows the apparatus as attached to 3 horizontal tubular boilers at the Princeton Worsted Mills at Trenton, N. J. Figure 2 shows the arrangement of the apparatus on a boiler, the live steam being carried to the bottom of the 3-way valve and a drip provided to remove all moisture before steam enters the valve.

Three sections are supplied by the 3-way valve and each section has a pipe leading from the valve to a header which goes across the front of the boiler. From this header, a drop pipe comes down in front of each vertical row of tubes and in front of each tube a siphon nozzle is inserted into the drop pipe, sending a blast of steam and air through the tube when steam is turned on.

By turning the handle of the 3-way valve 1 point, dry steam is admitted into the first section and is allowed to flow not more than 0.5 minute; the handle is then moved another point giving steam to the second section, and shutting off the first, and this is repeated for the third section. By the reverse motion, the tubes are given another half-minute blowing out, the whole operation occupying not over 5 min. to a boiler, and involving no disturbance of the fire or boiler pressure of any part of the furnace.

By the use of this blower 2 or 3 times a day the boiler tubes are kept always clean, and as a drip is provided in the steam supply, no wet steam is blown into the tubes to cool them and cause starting of the joints.

The apparatus is attached to the boiler head by an adjustable hanger with universal joints so that the header and drop pipes can be thrown above the top row of tubes when repairs are needed to the tubes.

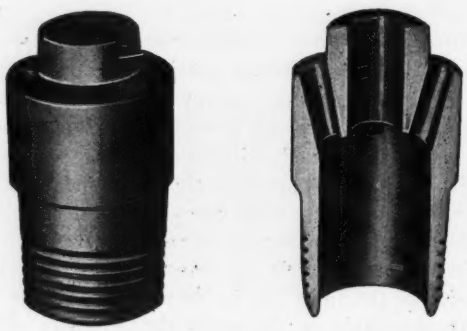


FIG. 3. NOZZLE USED IN AMERICAN FLUE BLOWER

Figure 3 shows the construction of the blowing jet, which is of steel and of siphon form so that air is drawn in with the steam.

It is stated by the makers of the American flue

cleaner, the National Flue Cleaner Co., of Trenton, N. J., that much less steam is required to blow the boiler by this process than when using the ordinary hose and nozzle, and that it is not necessary to use a scraper or brush on the tubes.

Steam is throttled at the cleaner, thus lowering the steam pressure to that required for effective work in blowing the tubes, and where required, an independent gage and valve are installed so that the steam pressure shall be closely regulated to that desired.

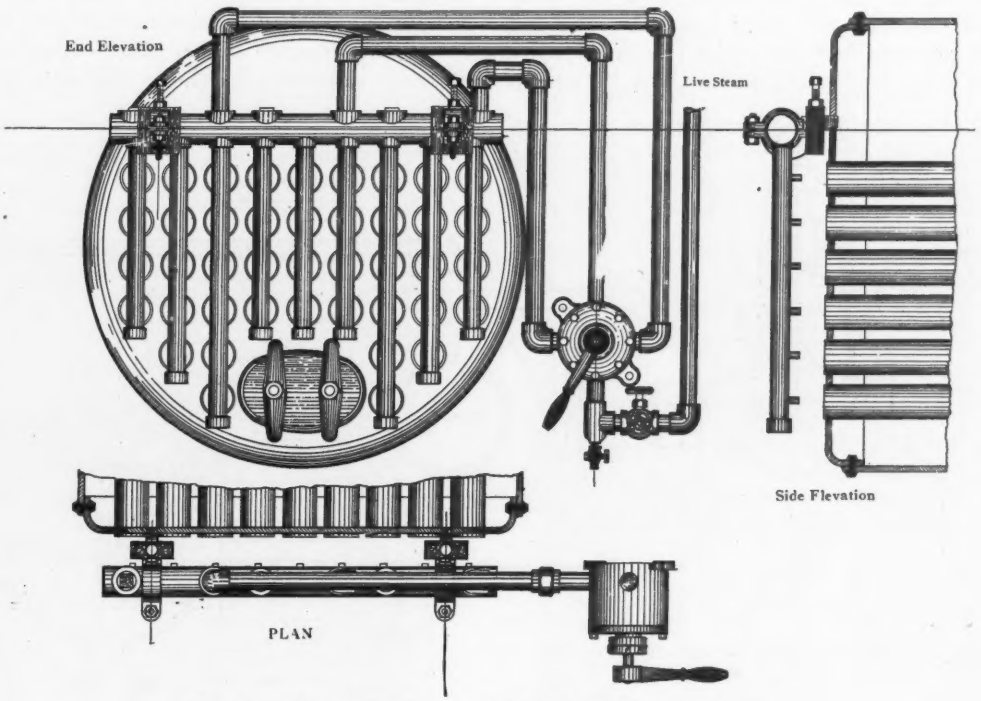


FIG. 2. ARRANGEMENT OF AMERICAN 3-SECTION BLOWER

THE LUCAS DOUBLE-ACTING TRIPLEX PUMP

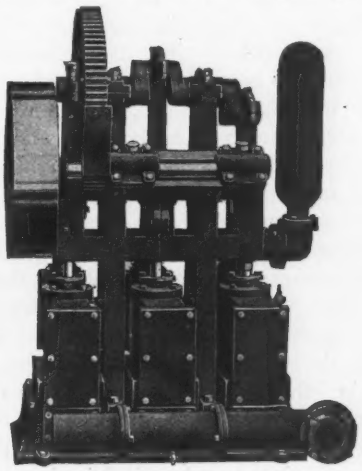
The cylinder of this double-acting triplex power pump is of a new patent design by which both the suction and discharge valves are placed on the outside of the valve decks in the valve boxes. This allows the valves, stems and grids, if necessary, to be reached and removed by taking off the cover plates shown, without taking the pump apart or stopping its running. The only packing required is where the piston rod passes through the head as shown in the cut; this rod being small, the friction is very light.

This design of pump gives a very even flow and may be used with either hot or cold water. The crosshead is made to be filled with oil covering this end of the connecting rod and wick oiling the guides. The pump may be operated by belt from an engine or line shaft, as desired, or geared from a motor. It is made by the Lucas Pump Co., Dayton, Ohio.

1.5 TO 2 SQ. FT. of cooling surface per horsepower are required in surface condensers.

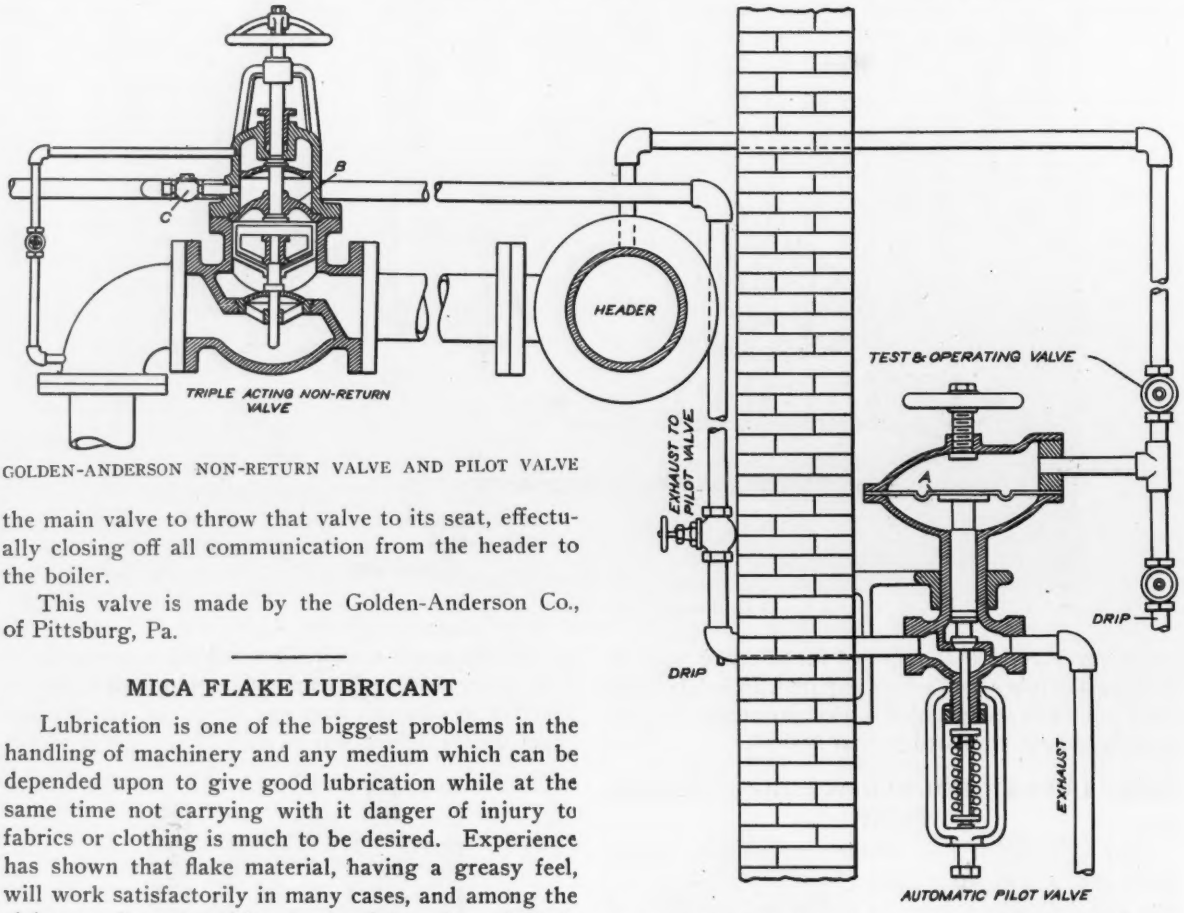
A TRIPLE-ACTING NONRETURN VALVE

In the Golden-Anderson nonreturn valve is found a device which is thoroughly automatic, always ready for service and requiring no adjustment. This valve, which is shown in section in the illustration herewith, is operated by an automatic pilot valve connected direct to the steam header. Four or more triple valves may be operated with 1 automatic pilot valve. Under ordinary conditions, pressure from the steam main bears on the upper side of the diaphragm A in the pilot valve, holding the pilot valve to its seat against the pressure of the spring in the bottom casing and preventing the steam from escaping from above the partition B of the triple-acting nonreturn valve. So



THE LUCAS DOUBLE ACTING TRIPLEX PUMP

long as the steam is contained in this chamber, the pressure on the under side of the upper piston tends to balance the pressure on the top of the valve disk proper and the valve remains open. If, however, the pressure in the header falls, the spring in the automatic pilot valve will force the valve disk from its seat, allowing the steam to escape from the triple-acting valve through the check valve C. This will relieve the pressure from the under side of the upper piston and allow the rush of steam above the disk of the main valve to throw that valve to its seat, effectually closing off all communication from the header to the boiler.



GOLDEN-ANDERSON NON-RETURN VALVE AND PILOT VALVE

This valve is made by the Golden-Anderson Co., of Pittsburg, Pa.

MICA FLAKE LUBRICANT

Lubrication is one of the biggest problems in the handling of machinery and any medium which can be depended upon to give good lubrication while at the same time not carrying with it danger of injury to fabrics or clothing is much to be desired. Experience has shown that flake material, having a greasy feel, will work satisfactorily in many cases, and among the claimants for recognition is the flake mica which is used in the same manner as graphite.

Graphite is admitted to be a good lubricant and for the mica flake are claimed the same qualities that the graphite possesses and some advantages that graphite does not have. The mica used for a lubricant is a white mica, ground to a certain degree of fineness according to the varying needs of different machines. It is a flake lubricant, to be used in connection with lubricating oils, the flake formation being of vital importance because even when ground to the finest grade used, it is still flaked and each flake has two perfect faces which hold the parallel surfaces with evenness.

These flakes enter into every crack and crevice in the rotating faces, so that, if any bearings are irregularly worn, the flake fills in and overlays the roughened surface, until a new surface results. This gives the lubricating oil full play and actually holds the bearing surfaces apart.

Among the special advantages of mica flake are, that it will not cake or harden; that it cannot be crushed out of service; that it cannot be greased out of the bearings; that it is cleanly and of itself will do no damage to any material or clothing; that it is light and economical and a pound of it will go a long ways.

Usually an ounce of mica flake is mixed with a pint of oil and experience has shown that with this mixture, the life of lubricating oils may be doubled. Of course. increasing the efficiency of lubrication decreases the friction and cuts down the power used in the bearings of machinery. The Mica Flake lubricant comes in 6 grades, 5, 10, and 25-lb. cans, and is made by the United States Mica Co., 240 LaSalle St., Chicago.

FROM THE TEMPERATURE of incoming and outgoing brine in the number of gallons pumped a minute, the capacity of a refrigerating machine can be reasonably well determined. The rule is, multiply the difference in brine temperature expressed in degrees Fahrenheit by the gallons of brine pumped per minute, and divide by 25. The quotient will be the refrigerating capacity in tons of ice for 24 hr. This is about twice the number of tons of ice that would actually be made on account of the cooling off of the water before freezing.

ALLOYS OF COPPER-TIN-LEAD

The art of producing bearing metals, containing under 7 per cent tin, and over 20 per cent lead, the balance copper, was pursued long ago by Andrew Allan, Sr., of New York, who invented a secret process by which copper and lead may be alloyed in any proportion with or without the use of tin and a perfectly homogeneous mixture obtained. Castings weighing 1000 lb. and over can be produced without the slightest signs of segregation.

It is generally believed that a certain per cent of tin is necessary to assist in keeping the copper and lead homogeneously mixed. This is not the case. The

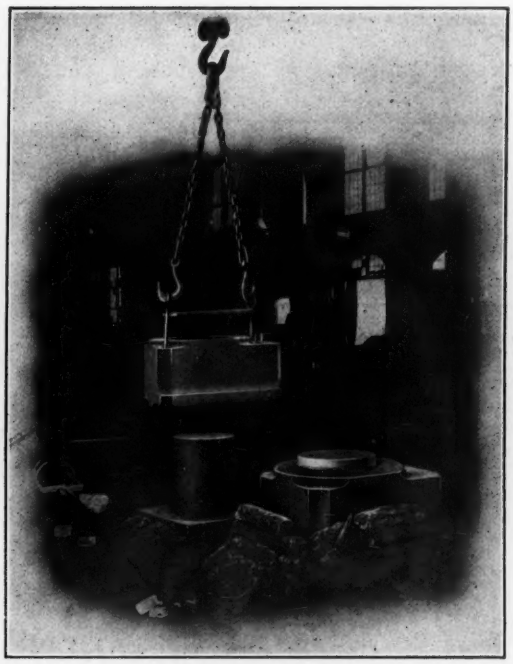


FIG. 1. FILLING MILL PINION BEARINGS WITH ALLAN METAL

introduction of tin into the alloy has no bearing whatever on keeping the lead from segregating from the mix, but is rather to harden the alloy and thus reduce proportionately its antifriction and wearing qualities.

The art of amalgamating copper and lead in any desired proportion with or without tin, was invented by Andrew Allan, Sr., in 1876; but it was not until 15 yr. later, 1891, that he started to place various alloys on the market under the name of Allan's Red Antifriction Metals, or Allan Metals. Starting on a small scale, he had to contend with many difficulties in introducing these alloys, but when their real merits became generally known by the engineering profession, the desired position among the bearing metals was soon gained for them. Large quantities of these metals were sold throughout the United States prior to 1900, tons were sold in Philadelphia prior to said date and bearing metal manufacturers were generally aware of their existence.

For years Andrew Allan, Sr., has claimed that no other metallurgist has mastered the art of amalgamating copper and lead with or without tin and not until they can produce castings as illustrated of alloys of copper and lead in any proportion, with or without tin, and have them homogeneously mixed without the slightest signs of segregation, have they the right to claim to be masters of the art.

Figure 1 illustrates filling mill pinion bearings; these bearings take 1000 lb. of metal to the cast; Fig. 2 shows a bushing for a guide bearing on an 8000-kw. Curtis steam turbine. These casts are homogeneously mixed with not the slightest sign of segregation.

Allan Metals contain less than 7 per cent tin, and

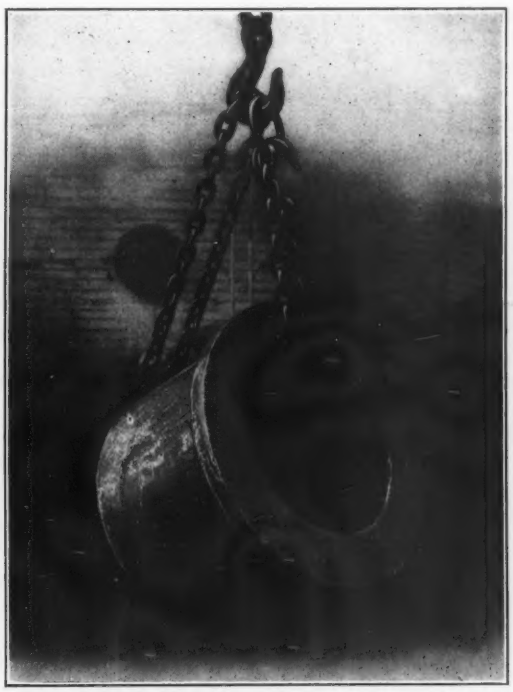


FIG. 2. BUSHING OF ALLAN METAL FOR A CURTIS STEAM TURBINE SHAFT GUIDE BEARING

over 20 per cent lead, balance copper, although in fact most of these formulas do not contain tin. For the past 18 yr. they have provided an alloy for journal bearings, which holds up within itself more lead than was before possible without the use of nickel.

Andrew Allan, Sr., learned from experience that tin, nickel or other metals added to the lead-copper mixture, were quite injurious to the antifriction and wearing qualities of the lead and without raising the melting point rendered the mixture hard and brittle and not adapted for high grade service, such as facing locomotives, marine and stationary engine steam pistons, piston rod packings for superheated steam service, bearings for mill pinions, rolling mill and central station engines, etc. Tin, especially, because of its adhesive qualities, he found to be a very undesirable element in these alloys, when a high grade antifriction metal was wanted.

TRANSMISSIONS AND THEIR LUBRICATION

In many plants of our various industries, especially in those of the smaller ones, are found installations that have long outlived their usefulness, or have become out of date and have not been rebuilt, partly due to the fear of excessive cost or a possible shut down.

One point of neglect is in the shafting, the initial installation of which likely did not permit a large expenditure for the entire development and in many instances was planned and erected by inexperienced parties.

If the reconstruction should be found too expensive or possibly inexpedient, the manufacturer should at least adopt a method to utilize his power efficiently.

In what simpler way can this be accomplished than in the selection of an efficient lubricant? Some think that oil is oil, and grease is grease, whereas there are few things which, having the same name, will differ so much in composition and quality as various lubricants.

Waste is most noticeable on line shafting, but the usual friction loss would be materially reduced by the use of an efficient lubricant, such as Albany Grease, which combines the lubricating element of oil and tallows with the tenacity and viscosity which insure lasting and cooling properties without waste. This efficiency in lubrication reduces friction to a minimum, which in turn increases the power transmitted.

In many plants the bearings are lubricated with sight feed oilers, and barrel after barrel of oil is thoughtlessly put into the bearings of which at least half is lost, by dripping to the floor or along the bearing supports, the appearance of which is decidedly unclean to say nothing of the consequent fire risk and expenditure necessary in the course of a year for constant attention and attendance.

An oil should form a thin and equally distributed film between the rubbing surfaces of the shaft and bearing and of itself possess great slipperiness so that the rubbing of the parts be only in oil. Should this oil become too thin, the film will be torn apart, and the oil forced to that portion of the bearings where it is least required, where the pressure is least, while that part having the heavy pressure will be dry and have metal upon metal, producing a hot-box, the bane of every engineer.

It is evident that the perfect lubricant is one, the consistency of which must change with its fluidity and thereby have a capacity for storing and carrying away heat; in other words, must have the property of keeping a bearing cool.

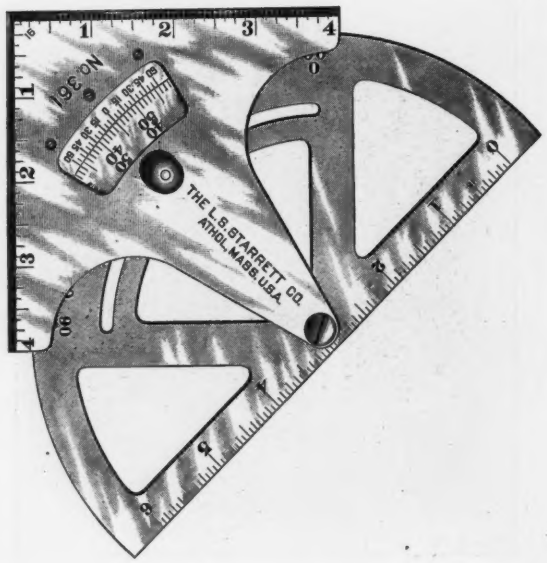
This can be accomplished with a neutral grease of uniform quality, having comparatively low melting points, so that it will melt readily and thus lubricate, cool and preserve the bearing, such a lubricant being found in Albany Grease, which has been on the market and in extensive use for over 40 yr.

In many plants this grease has been adopted as a standard, due to its efficiency, economy and uniformity. It can be used in any grease cup and its adaptation to all machinery can be made at a small cost for any bearing or installation. When spindle cups are used the consumption is small and the slight changes needed will be paid for within a reasonable time.

In medium or smaller plants where no extra oilers are in attendance on the transmissions, Albany Grease lubrication is desirable, as the inspection is intermittant.

A CONVENIENT PROTRACTOR

Made of sheet steel, graduated in degrees to read from either right or left, fitted with vernier to read to 5 min. and with the 3 straight edges graduated to read in inches and 16ths, this is a most convenient tool for those who have drawing or laying out work which



THE STARRETT PROTRACTOR

requires other than right angles. The lock nut holds the arc fast when adjusted and serves as a convenient handle. It is nickeled and is finished with the greatest care, as are all the tools made by the L. S. Starrett Co.

TESTS MADE AT St. Louis in 1906 showed that of more than 100 coals from the Mississippi Valley and the eastern states, some of which had been regarded as of no value for coke, only 6 when carefully manipulated, failed to make good coke for the foundry and other purposes. Similar results have now been obtained at Denver with western coal. Great care has been taken in getting the samples directly from the mines to secure the coal as it comes from the vein and to see that it reaches the testing plant in exactly the same condition as when taken.

Results obtained and methods developed by the Survey are showing that much that we have heretofore considered as refuse is good commercial fuel and the wealth of the country is being increased by just the amount of fuel resources thus added.

ANNUAL CONVENTION OF THE CONNECTICUT STATE ASSOCIATION OF ENGINEERS

Held at Waterbury, June 25 and 26

THE convention was opened at 8 p. m. Friday, with an address by Mr. Crane, of Waterbury, who spoke briefly of the work of the steam turbine and introduced as the speaker of the evening, L. L. Willard of the Allis-Chalmers Co., who spoke on the low-pressure steam turbine.

Mr. Willard's speech was of great value and will be abstracted at considerable length in a later issue. Following this Jack Armour entertained members with a series of stories and jokes and was followed by state secretary C. B. Osborne, who simply paid his respects to the visiting delegates and then gave way to past national president, P. H. Hogan, of Massachusetts.

Mr. Hogan gave a brief outline of the work that had been done by the Massachusetts State Association, from its organization in 1896 including the perfection and protection of the engineers' license law, providing lecturers for the subordinate associations, without expense to the association except occasionally for traveling. He invited the Connecticut delegates to be present at the Massachusetts State Convention.

Mr. Hogan emphasized the fact that nearly every state is drawing out from the national treasury in mileage paid to delegates who attend the national convention, more money than the associations in the state are paying and that something will have to be done about this matter in a short time. Adjournment was then taken until the following morning.

CONNECTICUT ENGINES AT THE WATERBURY CONVENTION

Saturday

The meeting was called to order promptly at 9 o'clock and was addressed by State President George P. Thomas. He spoke of the increase in membership of the association throughout the state and expressed his regret that he had not been able to do more to make this increase still larger. He advocated frequent visitations by the state officers of subordinate associations, stating that the only reason he had not done this himself was because of his location in one corner of the state and because of sickness in the family, that prevented his being away. He also advocated a Fall meeting of the state officers, committees, and president to arrange plans for the winter's work, lectures, etc.

Roll call of officers and delegates showed 8 associations represented with all officers present.

The educational committee reported the successful organization of a lecture list, the lecturers being supplied by the large engineering supply houses, furnished without charge. Open meetings have been well attended and have been provided with some stories and refreshments as well as the lecture. In all cases these have been the most successful and have resulted in a healthy growth to the organizations where they

have been held. The co-operation of all associations in the educational work was urged by Messrs. Cleveland and Ostrander.

The secretary reported the addition of one new association to the state organization and the death of Mr. Keppy, one of the oldest members of the association and one of the founders of No. 4. The treasury was reported in prosperous condition.

Election of officers resulted in the following: President, George Cleveland; vice-president, Mr. Ostrander of Meridan; secretary-treasurer, Mr. Vanderburg; conductor, Mr. Cassidy; storekeeper, Mr. Chapman; trustees, Messrs. George Cleveland, C. J. Grace and George J. Thomas.

After the election, P. H. Hogan of Massachusetts commended the choice of officers and urged that some one be sent to represent the association at Springfield, Mass., and also that a careful selection be made in the state deputy for the coming year. The officers were then installed and a vote of thanks extended to the Waterbury Association for the entertainment during the convention.

At the convention the following firms were represented with interesting and attractive exhibits:

McLeod & Henry; Dearborn Drug & Chemical Co.; Donegan & Swift; M. Davidson Co.; F. E. Idell, exhibiting the Cochrane Feed Water Heater; Quaker City Rubber Co.; Jenkins Bros.; Garlock Packing Co.; Home Rubber Co.; W. R. Winn; The A. W. Harris Oil Co.; Perfection Grate Co.; Lake Erie Boiler Compound Co.; Ashton Valve Co.; Heine Boiler Co.; Hill Publishing Co.

A CUBIC INCH OF IRON weighs 0.27 lb., of steel 0.29 lb., of brass 0.3 lb.

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10 SQ. FT. of bare steam pipe wastes approximately 2 tons of coal a year.

MASSACHUSETTS CONVENTION OF THE N. A. S. E.

Springfield, July 8-9-10

SPRINGFIELD, Massachusetts, has long been known among its denizens and admirers as "The City of Homes," and to that title those who attended the recent annual convention of the Massachusetts State Association of the National Association of Stationary Engineers are disposed to add—"The Home of Hospitality." Certain it is that from the opening of the convention exhibit, on Thursday, July 8, to the close of the social functions on the evening of Saturday, July 10, nothing was omitted that could have been done by the Springfield committees and members of the local branch of the association to enhance the comfort and pleasure of the visiting brothers and friends. It may be truly said that to the untiring and competent efforts of the local management was largely due the pronounced and gratifying success that marked every phase of the convention.

GROUP AT THE MASSACHUSETTS STATE CONVENTION

Exhibit Opening

The convention events began with the opening of the machinery exhibit in Graves building on Thursday noon, July 8. The exhibit was the largest of the kind that has taken place in western Massachusetts, and in itself marked a notable advance in the progress and importance of the association. The exhibits were attractively displayed in tastefully decorated booths and were so numerous that it was found necessary to secure 2 floors of the building for their accommodation. This feature of the convention attracted large throngs of interested visitors both day and evening during the time it remained open. Among the firms that contributed large and interesting displays were:

Gray Coupling Co., represented by H. W. Hill;

Crosby Steam Gage & Valve Co., represented by F. M. Griffin; American Oil Co., represented by S. F. Babbitt, and A. H. Williams; Pennsylvania Flexible Metallic Tubing Co., represented by Geo. F. Turner; Home Rubber Co., represented by A. R. Foley; W. J. Hyland Mfg. Co., represented by W. J. Hyland; Greene, Tweed & Co., represented by F. E. Ransley; M. T. Davidson Co., represented by Thos. Elliott; The Oliver Howland Co., represented by D. P. Donahue; Strong, Carlisle & Hammond Co., represented by C. J. Howe; The Beacon & Donnovan Engine Co., Springfield; McLeod & Henry Co., represented by John W. Foote; Holyoke Valve & Hydrant Co., represented by Geo. H. Stobbs; Marco Packings, represented by W. E. Sanders; Bemis & Call, represented by A. L. Cordner; Knowlton Packing Co., represented by D. B. Wakeley and F. E. Putney; Strong Supply Co., represented by L. E. Strong; Patterson Lubricating Co., represented by W. J. Patterson; The Lagonda Mfg. Co., represented by W. J. Patterson; Roe Stephens Mfg. Co., represented C. G. Winther; Dearborn Drug & Chemical Works, represented by P. H. Hogan; Grip Coupling Co., represented by L. H. Moore; Enterprise Rubber, represented by Gordon Hall; Enterprise Rubber, represented by J. E. Stevens; Jenkins Bros., represented by R. H. Stiles; W. R. Winn Co., represented by J. B. Hamilton; Chapman Valve Mfg. Co., represented by T. H. Ward; Perfection Grate Co., represented by C. V. Campbell and Geo. Bryce; American Radiator Co., represented by E. M. Stevens; Howe Safety Boiler Co., represented by H. V. Emmons; Grigs Coupling Co., represented by W. E. McClay; Wyckoff, Lloyd Co., represented by H. W. Lloyd and P. S. Rogers; Garlock Packing Co., represented by P. S. Rogers and J. S. Grayson; W. R. Norris, represented by W. N. Wanacis; Quaker City Rubber Co., represented by W. H. Howe; Hydro Palm Soap Co., represented by A. C. Wallis; Burke Engineering Co., represented by Geo. H. Burke; Keystone Lubricating Co., represented by Geo. H. Mahan; Adam Cook's Sons, represented by M. V. Pearcy; H. W. Johns-Manville Co., represented by Geo. H. Kendrick, Mgr.; Feader Burgman, represented by W. H. Wardwell; Ashton Valve Co., represented by H. H. Ashton and C. W. Houghton; Williams Gage Co., represented by H. E. Watt; Monarch Valve Mfg. Co., represented by W. D. Hasley; Federal Metallic Packing Co., represented by H. W. Rand; The M. W. Kellogg Co., represented by H. R. Austin; Dean Steam Pump Co., represented by B. N. Potter; Eagle Oil Supply Co., represented by C. H. Andrews; American Steam Gage & Valve Co., represented by A. S. Pollard; The Mason Regulator Co.; Liberty Mfg. Co., represented by Geo. H. Gray; Brewer & Co., represented by R. F. Blackbarn; New England Roller Grate Co., represented by W. J. Crapy; Gardner Grate Co., represented by F. R. Gardner; Lukenheimer Co., represented by W. W. Beal.

First Session

On Friday the delegates assembled for convention work in Lennox Hall, and were called to order by W. H. Damon, state treasurer and chairman of the Springfield committee of arrangements. He introduced Mayor Saunderson, who welcomed the delegates to Springfield in cordial terms and warmly commended the principles and methods of the association.

E. H. Kearney of Boston, state deputy, responded. On rising he voiced the delegates' appreciation of the mayor's greeting and of Springfield's hospitality. He then spoke earnestly and convincingly on the aims and principles of the association, and showed its potency in advancing the best interests of its members through elevating the standard of personal and professional efficiency and securing the adoption and maintenance of appropriate legislation.

C. H. Ostrander, vice-president of the organization in Connecticut, followed, paying high compliment to the Massachusetts Association not only for growth and success, but also for securing the enactment of laws that established a high standard of competency among the engineers of the state. He adverted to the fact that 4 yr. of effort to obtain such laws in Connecticut had thus far failed.

President Ole Peterson, of Boston, made a brief address in which he extolled the Springfield branch of the organization, complimenting it as the largest in the state. On rising he was greeted with enthusiastic cheers, and later was presented by Past National President P. H. Hogan with an ebony gavel suitably inscribed.

After the close of the morning session the delegates visited by invitation the fine new plant and building of the Phelps Publishing Co., where they were hospitably entertained.

Friday Afternoon

At 2:30 o'clock the delegates reassembled in Lennox Hall and after completing routine business elected the following officers for the ensuing year: President, P. V. Tirrell of Haverhill; vice president, George L. Finch of East Cambridge; secretary, James H. Summer of Cambridge; treasurer, Walter H. Damon of Springfield. The reports of officers for the past year showed a satisfactory condition of progress and prosperity.

On Friday evening a banquet was given the delegates and visiting friends at the Cooley Hotel, the great dining hall of which was taxed to the utmost to accommodate the large party assembled. The guests present numbered about 300. While assembling for the banquet and during its discussion, the party was entertained with excellent music by an orchestra of 16 pieces.

When the good things of the table were disposed of, Treasurer W. H. Damon called the party to order and opened the program of mental refreshment by a brief and appropriate address, at the conclusion of which he presented Past National President H. E. Stone of New York as toastmaster. Mr. Stone was greeted with enthusiastic plaudits and in an excellent and effective address recited the history and progress of the order in Massachusetts from its organization in 1896 to the present time. He spoke of the principles and achievements of the organization; of the educational benefits that accrued to the engineer from membership in it and of its characteristic policy of noiselessly but persistently doing good. In concluding he introduced as the next speaker W. J. Reynolds of New Jersey, national vice president. Mr. Reynolds responded briefly, thanking the members for the cordial greeting extended and strongly complimenting the Massachusetts organization on the excellence manifested in all details of the convention.

"Jack" Armour, the funny man of Power, was next called on and gave a number of songs and recitations which afforded much entertainment and were warmly applauded.

State Deputy Kearney of Boston was next introduced and made a very competent and effective speech on the work and progress of the order.

P. H. Hogan, as the first president of the association, responded in a pleasant and happy manner and

warmly congratulated Massasoit No. 2 of Springfield for its part in the success of the convention.

The next speaker called on was Fred R. Law, "Mayor of Passaic, N. J., and editor of Power." Mr. Law humorously resented the toastmaster's allusion to his official position as mayor, saying that he was doing his best to live it down. He then spoke of the progress made by education in the character of the engineer of today and gave some advice as to the methods by which his progress might be continued and accelerated.

Mr. Hathaway, secretary of the Springfield Board of Trade, which organization had cordially co-operated in the preparations for the convention, spoke briefly, recognizing the indebtedness of the manufacturer to the competency and faithfulness of the engineer, and emphasizing his value as a factor in the industrial importance of Springfield.

After a few other speeches by prominent guests the party adjourned with the feeling that a very successful day had been brought to a pleasant and satisfactory close.

On Saturday morning the convention closed its business in a short session which was called to order at 9:30 o'clock, when Fred R. Law of Power gave a lecture illustrated with blackboard drawings. After the session ended, the delegates assembled at the Cooley Hotel and marched in procession to the plant of the United Electric Light Co., which they inspected under the guidance of Superintendent W. H. Damon, state treasurer of the association, whose work as chairman of the committee of arrangements contributed so much to the success of the convention. Luncheon was served to the party at the electric light station, after which they embarked on the steamer Sylvia for an outing and grove dinner at Riverside on the Connecticut river. A pleasant incident of the visit to the electric plant was the presentation to Superintendent Damon of a set of gold cuff buttons, stick pin and signet ring, contributed by the exhibitors at the convention.

The Stevens band accompanied the party to the grove and contributed much to the pleasure of the outing. When the grove was reached there was a ball game between a nine from the engineers and one from the supply men, in which the former won "the pennant" by a score of 14 to 6. Following the ball game was an excellent clam bake with abundance of fresh boiled lobster and all accessories, which was thoroughly enjoyed and loudly praised by all present. After a further brief indulgence in field games the party re-embarked and enjoyed "a jolly time" back to the landing place. There they formed in procession and headed by the band marched through Main street to Cooley's Hotel, which was reached about 6 o'clock p. m. On reaching the hotel the party disbanded and so brought to a close one of the most successful and enjoyable conventions ever held by the organization in Massachusetts. The local committee of arrangements to whose efforts the success of the occasion was largely due consisted of the following members: Walter H. Damon, chairman; E. E. Brigham, A. R. Bremmer, William Davidson, J. F. Quinn, W. D. Packard and J. J. Murphy.

The Massachusetts State Association was organized in 1896, and has now a prosperous membership of about 1,700. The next convention will be held at Worcester, July 14, 15 and 16, 1910.

WE CAN ONLY BE VALUED as we make ourselves valuable.—Emerson.

MICHIGAN STATE CONVENTION OF ENGINEERS

Bay City, July 15 to 17.

IN the opening address of welcome by Mayor Evans, attention was called to the benefit of co-operation in every calling. The usual hospitality of the city was extended in a graceful manner and then A. B. La Franier of Bay City, president of the Michigan Association, replied to this address, wishing success of the meeting, emphasizing the importance of the engineer and carrying its part:

"We realize that no class of workmen represent a calling which is of greater value to mankind than ours, for the skill and labor of the engineer has become indispensable. He is a vital part of the progress of the present day, and industrial enterprise and commercial growth demand his services constantly from the rippling waters of the Atlantic to the rolling seas of the Pacific, and from the frozen regions of the north to the sunny flower gardens of the south, this association has placed its seal of good fellowship and progress upon the profession of steam engineering."

F. W. Raven, national secretary from Chicago, emphasized the need of state license laws and the value of the exhibits at the convention to those engineers who carefully examine them. Addresses in similar vein were made by Aaron T. Miller and John A. Kerby, calling attention to the progress already made and to the possibilities of the future.

The meeting was then addressed by Edward G. Jacques, past national president, on the relation of the Engineer to his Employer, his special point being the need of proving to the employer the advantage which the engineer gains by attendance at the convention meetings. The meeting was then taken in hand by President La Franier for the transaction of regular order of business.

Friday was taken up with the reports of committees, routine business, and an auto ride around the city, the evening being given up to a trip to Wenona Park. The closing day of the convention was occupied with the election of officers and selection of a place for meeting next year, Kalamazoo being chosen. The officers elected are as follows: President, A. C. Benton, Battle Creek; vice president, H. F. Brandau, Detroit; secretary, Ezra C. Smith, Kalamazoo; treasurer, W. H. Hayton, Detroit; conductor, A. D. Sharres, Flint; doorkeeper, F. H. Tibedeau, Detroit; trustees, John Andrews and W. E. Fuller.

In the afternoon a baseball game between the engineers and the supply men took up the time and the evening was given up to an excursion down the bay on the steamer State of New York.

In a hall in the Ridotto building a pretty exhibit was arranged by the supply houses and the machinery manufacturers and this was open to the engineers of the city as well as the delegates at the convention.

Exhibit Notes

THE WM. POWELL CO., of Cincinnati, O., arranged an interesting display of its line of engineering specialties and brass goods, which included the celebrated White Star line of valves, Union disk valves, oil and grease cups, etc. M. F. Brenner looked after the company's interests in an energetic manner.

NO CONVENTION, either state or national, would be a success without representatives from the Hawkeye Compound Co. of Chicago in attendance. On this occasion W. F. Ebert was found doing the honors for the company, assisted by R. M. Rochfort and Theo.

Saindon. Some interesting literature was distributed and watch fob souvenirs were given to delegates and visitors.

CRANDALL PACKING CO., of Palmyra, N. Y., was represented by C. W. Scott, of the Cleveland office. In an attractive booth was displayed a general line of packings including Regina sheet packing and a special featuring of the No. 116 "Lip" hot water packing. Mr. Scott was ably assisted by Mrs. Scott, who seemed to enjoy the business and social features of the occasion thoroughly.

V. D. ANDERSON CO., of Cleveland, O., distributed literature featuring the Anderson line which included steam traps and floats, both of which were on display and

Standard vertical water-tube type boiler in full operation. Delegates and visitors were interested in this demonstration as the operation of the model showed both the circulation and fire travel. Actual working models have always attracted attention, but a sight of the inside of a boiler under steam pressure impressed every one as being out of the ordinary. Louis Beebee of the home office was in charge and explained the working features of the boiler in an interesting way.

GEORGE COLLINS AND H. S. BRYANT of the Jennison Hardware Co., of Bay City, kept open house in the company's booth, where they displayed a general line of engineers and machinists' tools, brass goods, valves and fittings and the Dodge Mfg. Co.'s transmission goods.

DELEGATES AND GUESTS AT BAY CITY

attracted a great amount of attention. The booth was in charge of Jos. H. Meyer.

ONE OF THE SPECIALLY INTERESTING DISPLAYS was that of the H. W. Johns-Manville Co. which was in charge of H. A. Pierce and F. L. Postal of the Detroit office. The exhibit consisted of a full line of asbestos goods, packing in sheet, ring, spiral and gasket form, roofing and electrical supplies, steam hose, a J-M asbestos pipe covering for every condition, liquid and dry powder chemical fire extinguishers and friction tape. Whenever Mr. Pierce thought special attention should be centered in his direction, he put in operation an improvised wireless telegraph system. It made a noise all right, and at a convention anything making a noise makes a hit.

AN EXHIBIT THAT ATTRACTED UNUSUAL INTEREST was that of the Wickes Boiler Co. of Saginaw. In this booth was shown a perfect glass model of the company's

Souvenir oil stones of carborundum and Morse twist drill charms were distributed.

GARLOCK PACKING CO., of Palmyra, made a specialty of its No. 900 sheet packing. Its booth was attractively arranged and in charge of A. H. Carr and C. E. Briggs of the Detroit office, who were conspicuous in both business and social affairs of the convention. Souvenir cigar cutters were distributed to all delegates and visitors.

PENNSYLVANIA FLEXIBLE METAL TUBING CO., of Philadelphia, displayed a line of metallic hose ranging from the smallest to largest sizes. M. W. Nelson of the Detroit branch was in charge of the booth.

J. T. WING & CO., of Detroit, displayed Wing's High Speed babbitt metal and distributed literature which told of its merits. Fred Hewitt was in charge of the booth and where a visitor wanted one and was big enough to

carry it away, he very graciously bestowed a good sized steel magnet as a souvenir.

ANCHOR PACKING Co., of Philadelphia, had 2 hustling representatives in E. C. Adams and F. A. Kohl of the Detroit office. They displayed a complete line of metal and fibrous packings and to delegates registering their names, a souvenir of the occasion in the form of a well made pocket knife is to be mailed later. The exhibit was a success, Mr. Adams personally contributing largely to the social pleasures of all in attendance.

MECHANICAL RUBBER Co., of Cleveland, O., made a very attractive display of Marco packings and other specialties. W. E. Sanders, manager of the packing department, ably looked after the company's interests, explained the good points of Marco to man, woman and child, and whenever there was a lull in the procession, old man "Bill" was called in to the rescue.

ALERT PIPE & SUPPLY Co., of Bay City, had 3 representatives looking after its interests: W. T. Bronson, R. F. Birchard and A. McLachlan. They exhibited a line of engineering and mill supplies.

THE LUNKENHEIMER Co., of Cincinnati, had an attractive booth displaying a full line of its valves, lubricators, oil cups and other brass goods. C. G. Strong did the honors for the company.

GREENE, TWEED & Co., of New York, had a prominent booth displaying the celebrated Palmetto packing working samples of which were distributed to the delegates and visiting engineers. F. E. Ransley was in charge of the booth.

WHILE THE DEARBORN DRUG & CHEMICAL Co., of Chicago, did not occupy a booth, it contributed to the cause, and Otto Fluegel of the Detroit office was on hand to see that it was not forgotten. The lady visitors at the convention were the recipients of handsome bottles containing perfume which is one of the company's products and which are frequently distributed on occasions of this kind.

LAGONDA MANUFACTURING Co., of Springfield, O., displayed a line of boiler tube cleaners and specialties. Engineers were greatly interested in what the representative, Fletcher Field, told them about the good points of Lagonda apparatus, and if there is anyone in Bay City who doesn't know what the Lagonda Co. makes, it is because he wasn't there.

THE UNITED SUPPLY Co., of Saginaw, Mich., displayed a general line of engineers' and mill supplies and also displayed the Swartwout specialties manufactured by the Ohio Blower Co. of Cleveland. H. W. Sullivan was in charge of the booth, assisted by J. D. Swartwout, vice-president and treasurer of the company.

E. H. WEBSTER looked after the interests of the American Steam Gauge & Valve Co. and displayed in the Alert Pipe & Supply Co. booth the American Thompson Improved Indicator and other specialties.

AARON MILLER and wife distributed souvenir caps and small barrels of tobacco to all delegates and visitors who were interested in the exhibit of the Lake Erie Boiler Compound Co.

VIEW OF THE EXHIBIT HALL AT BAY CITY

KENNETH ANDERSON MANUFACTURING Co., of Detroit, displayed a general line of engineer and mill supplies including Homestead valves and the Copes boiler feed regulator. The booth was in charge of Howard Gurney and A. C. McCreery.

KEYSTONE LUBRICATING CO.'S EXHIBIT

JENKINS BROS.' booth was attractively arranged, showing a line of extra heavy Jenkins valves and '96 rubber goods. A. T. Ahrens looked after the affairs of the company in a painstaking manner and added new friends to its already large list.

KEYSTONE LUBRICATING CO., of Philadelphia, showed samples of Keystone Grease and distributed some interesting literature. W. E. Toohey of the Chicago office was in charge.

THE UNDERFEED STOKER CO. OF AMERICA distributed a lot of interesting literature about The Jones stoker to every one in attendance at the convention. G. H. Umphray, state agent, with offices at Detroit, and F. E. Fleming of the home office, looked after the interests of the company.

ARROW BOILER COMPOUND CO., of St. Louis, had the merits of its product ably presented by E. M. Swindler, district manager of sales. When one couldn't get anything else to taste, Mr. Swindler produced a vial of compound which he insisted should bear the inscription, "The More You Eat, The More You Want," as it was both harmless and nutritious.

C. C. HARRIS of the Chicago office of the Quaker City Rubber Co. was one of the convention visitors.

JAMES D. POUNDS, assistant sales manager of the Northern Equipment Co., Chicago, Ill., was at the convention in the interests of his company, which manufactures the Copes boiler feed regulator.

W. H. MOORE, manager and mechanical engineer of the Buckeye Chemical Co. of Detroit, mingled with the convention crowd and was kept busy with business and pleasure.

AMONG OLD FRIENDS whom we always expect to meet at conventions was Silas Cook, representing Adam Cook's Sons of Albany Grease fame.

AMONG THE TRADE PRESS representatives were O. Monnett, representing Power, T. W. Bailey of National Engineer, and Chas. S. Clarke of Practical Engineer.

NEWS NOTES

FROM THE 9TH TO THE 14TH OF AUGUST will be held at Spokane, Wash., the 17th session of the National Irrigation Congress, in which the work already done by the government will be reviewed and future activity outlined. More than 2,000,000 acres of land are already under irrigation in the western states and it is expected that 5,000,000 acres will be reclaimed when the works at present in progress are finished.

A proposition which will come up before the congress is the recommendation to congress of the issue of $5,000,000,000 3 per cent gold bonds running 100 yr., to be expended, $1,000,000,000 for drainage of overflowed and swamp lands to reclaim an area of 100,000 sq. miles, $1,000,000,000 for the irrigation of 40,000,000 acres of arid lands, $1,000,000,000 for constructing and improving deep waterways, $1,000,000,000 for good roads and national highways, and $1,000,000,000 for forest protection, reforestation and conservation of forest reserves.

It is estimated that about 100,000,000 acres is now overflowed which might be reclaimed, and the expenditures for drainage and for irrigation are estimated to make available land to the value of $10,500,000,000 capable of supporting 10,000,000 persons.

THE NEW TREATY OF PATENTS between the United States and Germany eliminates the requirements that the article be manufactured in the country issuing the patent. This permits the issuing of patents by either country and have them continue in force if the article is manufactured in the other country and imported. The treaty was ratified by the American Senate on Apr. 15 and by the German Bunderath on Apr. 22.

JULY 1, 1909, Benjamin Whittaker resigned as treasurer of J. H. Williams & Co., manufacturers of drop-forgings, Brooklyn, N. Y., and will give his entire time to the exporting business for the same company and others, with headquarters at 17 State street, New York.

THE MAURETANIA of the Cunard line on her eastbound trip finished in Liverpool on June 21 at 10:15 p. m., thus making a new record for the voyage from New York to Liverpool, and for the first time landing on Monday passengers who left New York on Wednesday. The trains for London were in waiting, and the actual time from New York to London was 5 days 8 hr.

FROM PARIS TO LONDON by airship is to be the next attempted feat of the balloonists. A big machine is proposed which will carry 25 persons and be capable of a voyage of 700 miles at 35 to 40 miles an hour. It will have 2 propellers and 2 motors each of 220 hp.

CUTLER-HAMMER MFG. CO., of Milwaukee, has purchased the plant and business of J. L. Schureman Co., of Chicago, and will until further notice continue the business at the old address in Chicago.

R. H. TOMLINSON HAS, for 5 yr., been in charge of engineering work in the Condenser department of the Allis-Chalmers Co., at Milwaukee. He has recently been given entire charge of the engineering in the Corliss Engine department as well as in the Condenser department.

GLEN M. PORTER, an old, experienced specialty man, and one of the best-posted men in the specialty business, formerly connected with the Liberty Manufacturing Co.'s Chicago office, has been transferred to New York, and in the future will have the management of the New York district, and be in charge of the New York office, assisted by C. S. Roosa.

MR. EDWARD G. DEWALD, heretofore manager of the Water Wheel department of the Platt Iron Works Co., Dayton, O., has become identified with the Hydraulic Turbine department of Allis-Chalmers Co., as special representative for the Pacific Coast, with headquarters at 599 Mission St., San Francisco. Mr. Dewald has been with the Platt company for the past 20 yr., during 5 of which he served as manager of its San Francisco office; and he has been identified with many of the largest hydraulic power installations in the country, including the majority of those on the coast. Mr. Dewald's prominence in this field, coupled with the success of Allis-Chalmers Co., during recent years, in the design and sale of hydro-electric machinery, make his new connection particularly noteworthy.

THE NEW FREDERICK AYER MILL of the American Woolen Co., now in process of erection, will have its boiler room equipped with Murphy Automatic Smokeless Furnaces. These will be the largest single units ever manufactured by Murphy Iron Works, each furnace being attached to a 600-hp. boiler, there being 8 in the initial installation.

Each furnace will be capable of burning over 4,000 lb. of coal per hour, and will weigh 55,000 lb. The plant will be completely automatic. The coal will be delivered to the furnaces, fed and distributed, and the ashes and clinker removed. The labor cost will, as a result, be decreased 50 per cent and a material saving in fuel will be effected.

CATALOGUE NOTES

SIGHT FEED OIL PUMP CO., of Milwaukee, has just issued its bulletin No. 210, which illustrates and describes Union-Cinch Fittings. The pamphlet contains, also, a price list and will be of interest to engineers.

PRESERVATION IS ONE OF Nature's laws, and R. F. Morse of Providence, R. I., helps out Nature

by providing the Gilbert gage glass preserver which keeps the glass steam and water tight without cracking the glass. Its merits are described fully in an interesting booklet just received. Sample free for those who write.

LAGONDA MFG. CO., OF SPRINGFIELD, OHIO, has just issued Catalog J, a handsome booklet describing the Weinland cleaners. This shows the 4-arm wing head, the 3-arm wing head, Porcupine head, the rocker arm head, cross section of the ball bearing turbine, and details of the different parts. The illustrations of how the cleaner does the trick are also interesting and instructive, particularly that one applying the feeding device for curved tube boilers.

IN INDUSTRIAL ENGINEERING for July a number of articles are found of interest to those engaged in power plant design and operation. The automatic control of electric motors by A. G. White the characteristics of mechanical stokers by I. E. K. Roberts and the division of work in a boiler by E. S. J. McGuire.

BULLETIN 1519 OF THE Allis-Chalmers Co. describes the Tomlinson Barometric Condenser Type "A N." In this condenser no dry air pump is required, but if the condensing system is maintained air-tight a vacuum of 28 in. can be produced.

WEBSTER SPECIALTIES is the title of a handsome and interesting booklet describing heaters, separators and vacuum heating systems as installed by Warren Webster & Co., of Camden, N. J.

POSITIVE PREVENTION OF ACCIDENTS from bursting of water gage glasses is an end much to be desired. Two pamphlets discussing this subject have recently been published by the American Steam Gauge & Valve Mfg. Co., Boston, Mass. One of these is How to Avoid Accidents and Lawsuits, the other is Lawsuits and Accidents Prevented. The guard is a handsome little device which closes around the ordinary gage and has the glass protected by wire glass windows. A light is provided which shows exactly the height of the water in the gage so that it is more clearly visible than before the guard was applied.

THE JULY STOCK LIST of the Scully Steel & Iron Co. contains, as usual, an interesting tabulation of tools for use in the boiler room, material for boiler construction and for use in boiler repairs.

GENERAL ELECTRIC CO. bulletins have recently been issued as follows:

No. 4,666 describes an improved form of the Type H transformer, of which the advantages are better efficiencies, greater uniformity of impedances, an improved connection board, together with an improved method of supporting the primary and secondary leads, and a new type of suspension hook, as well as a new device for clamping the transformers in the cases. The bulletin contains numerous illustrations of the transformer, and shows the methods used in the different processes of manufacture. Tables showing the frequency limits, and a curve indicating the reduction in the core and total losses of the improved Type H transformer over previous designs are also shown.

No. 3,670 covers gaskets and bell mouths for conduit wiring, marine railway car equipments and underground circuits. The illustrations in the bulletin consists of dimension diagrams of the soft rubber gaskets and metallic bell mouths, and a complete set of tables enables the customer to determine the size of bell mouths required for any particular service, and to ascertain readily the proper gasket which should be used with it.

No. 4,664 is devoted to a new line of direct connected engine driven railway generators, Form S, which embodies a number of improvements over previous types. The standard line of these generators range in capacity from 100 kw. to 2,700 kw., and the speeds have been carefully selected to adapt the generators for direct connection to steam engines. They are designed to run at constant speed, and for the prevailing full load railway voltages. The bulletin illustrates the generator and important parts, and gives a table of general dimensions.

HISTORY OF THE MARATHON RACES is the title of an interesting booklet by W. S. Farnsworth, which is sent out with compliments of Greene, Tweed & Co., of New York City, and shows not only the history of the battle of Marathon and the original run of the Grecian youth, but also the Marathon races as they have been run in modern years, with pictures of the winners.

A PROCESS FOR SOFTENING BOILER FEED WATER at the same time that it is heated is described in a 36-page booklet sent out by the Harrison Safety Boiler Works, 3144 N. 17th St., Philadelphia, Pa. In this process advantage is taken of the fact that heating water in an open spray drives off free and combined carbonic acid gas, resulting in the precipitation of carbonates, and that by further treating the water with a single reagent sulphates, chlorides, nitrates and acids can be counteracted, giving a softened water which will not corrode nor form hard scale in the boilers. The simplicity and inexpensiveness of this treatment are fully explained. The pamphlet contains much valuable information for the owners, designers, and operators of steam plants, as well as descriptions and illustrations of various installations, and in view of the fact that the steam boiler inspection and insurance companies find over 50 per cent of the boilers in use defective in ways which can be traced to impure feed water, it will doubtless find a large number of interested readers. Copies are distributed gratis upon application.

THE STORY OF SOME FRICTION TESTS is the title of a comprehensive booklet issued by the Quaker City Rubber Co., Philadelphia, Chicago, and Pittsburg. The relation of piston packings of various classes to friction as demonstrated by a series of exhaustive tests by eminent mechanical engineers, is clearly explained in this valuable little book. The edition was specially printed on coated paper and is attractively bound in red. There are many diagrams, test sheets and illustrations. Engineers and firemen can secure a copy free of charge on postal card request.

THE CROSBY FOR SUMMER is the title of a pamphlet explaining the value of a Crosby spring seat valve.

TWENTY-FIVE YEARS OF ROPE DRIVING is the title which is embossed on the handsome cover of a new catalog issued by the Dodge Manufacturing Co. of Mishawaka, Ind. It is a handsome piece of printing work worthy of the Dodge Manufacturing Co. and of the Russell de Wolf Co., which got it up. The topics discussed and illustrated are the use of rope drive in central station power houses, the design of rope drives, American vs. English system of rope driving, rope for mechanical power transmission, subdivision of power and provision for future needs, independent handling of large power units and the use of friction clutches and cutoff couplings, and following these topics a discussion and description of typical installations in service of all sorts. The book is 9 by 12

in., contains 104 pages and is a review of the development of the American system of rope transmission from its introduction by the Dodge Manufacturing Co. in 1883 up to the present time. It is fully illustrated with views and line drawings and is for free distribution to mill and factory managers, superintendents and engineers who write to the Dodge company at Mishawaka for it and mention Practical Engineer.

ISN'T THAT STRIKING and isn't it a beauty, is the involuntary comment when picking up the new 1909 catalog of J. H. Williams & Co. of Brooklyn, N. Y. A fac-simile of a red hot drop-forged wrench stands out from the cover in most realistic illustration of the product of the company. Inside, the catalog is just as much a beauty and has strikingly novel features. That it fully illustrates and describes the Williams superior drop forgings goes without saying. New goods are specially listed and indexed on page 7, so that old customers will know what to investigate specially; all tools listed are numbered so that the number tells the kind and size wanted, and no mistakes will be made in ordering. Dimensions and prices are given in full, too, so that you know just what you are ordering.

Page 8 indexes the tools by numbers as well as by name, so that in checking invoices or placing orders the customer can readily find the tool desired. At the back, the different processes of drop forging are described and illustrated and especial attention is called to the complete care taken in making tests in the chemical and physical laboratory to insure that specifications are followed exactly and the proper kind of material used for each class of work. This interesting book can be had on application to J. H. Williams & Co., Brooklyn, N. Y.

GOOD PUMPS INSPIRE GOOD BUSINESS is the striking title of a folder sent out by the Goulds Mfg. Co. of Seneca Falls, N. Y., illustrating and describing hand and power rotary and force pumps.

FROM THE A. S. CAMERON STEAM PUMP WORKS comes a folder explaining the exhibit of the Cameron pumps at the Alaska-Yukon-Pacific Exposition and giving some interesting views of the exhibition and applications of the Cameron pumps in the Western territory.

TRADE NOTES

AMERICAN DISTRICT STEAM CO., of Lockport, N. Y., has just closed contract with the Indianapolis Light & Heat Co. for a large underground system of heating covering the business district of the city.

ONE OF THE NOTABLE HAPPENINGS in Philadelphia recently has been a large increase in the capacity of the factory of the France Packing Co. and the addition of many labor-saving machines, so that this plant is now able to ship an order of metallic packing 2 days after receipt of the order, which gives the company a distinct advantage in meeting the needs of engineers.

France Metallic Packing has been recognized as a standard metallic packing for the last 10 yr. by the large engine builders throughout the country, and over 12,000 sets are now in use successfully packing ammonia, air and gas, as well as steam. Patents have recently been taken out by the company on improvements made in the gas and ammonia metallic packings.

While the specialty of the France Co. is metallic packing, it has always made fibrous packings, sheet, valve and other lines in a small way, but has recently materially increased this department and has now one of the finest fibrous packing factories in the country. These factories are located at Tacony, one of the pretty suburbs of Philadelphia, easily reached from the center of the city by trolley in 50 min. or by train in 30 min. and any one who has the time will find a visit of inspection to the plant well worth while and will discover that quality is the keynote of the organization and that all branches of the business are looked after by men of long experience in packing manufacture.

A new catalog has just been issued by the France Packing Co., fully describing all the different lines which it turns out, and this catalog, which contains a number of new things in the packing line, can be had by writing to the company at Tacony and mentioning Practical Engineer.

WHILE PACKINGS OF EVERY KIND and description were the principal exhibits of the H. W. Johns-Manville Co. at the Massachusetts State Convention of the National Association of Stationary Engineers, held in Springfield on the 8th, 9th and 10th of this month, a large line of rubber hose, matting and belting, both liquid and dry-powder chemical fire extinguishers, and some asbestos products were also shown.

The most prominent part of this exhibit was a sheet packing called "Permanite," which is apparently made exactly the same as the foreign packing which is said to be revolutionizing the packing business abroad.

George G. Kendrick, who is well known to the engineers as a member of the N. A. S. E. in Roxbury and as an attendant at the previous conventions, was in charge of this exhibit. Jas. Humphreys and W. W. Hosmer of the Boston branch were also on hand.

THE WISCONSIN ENGINE CO. took contracts during the first 6 months of this year for nearly a quarter of a million dollars worth of engines. These contracts included quite a number of small units running at speeds much higher than has heretofore been considered good practice for Corliss engines. These are called Higher Speed Corliss engines and they operate at 150 to 175 r. p. m. Some of these higher speed engines have been in operation for over 6 yr. with noticeably less wear and tear than can be noticed in the ordinary engine after 2 or 3 yr. service. Business on this type of engine is rapidly increasing and recent orders include 3 of these cross compound engines, each of 750 hp., which are to operate at 150 r. p. m.

This company has secured the largest blowing engine contract placed in many months, consisting of 3 large vertical engines for the River Furnace & Dock Co. of Cleveland, Ohio, a Corrigan-McKinney interest. The size of these engines is 46 and 84 by 84 by 60 in.

On the erecting floor of this company, nearly ready for shipment, are 5 Complete Expansion Gas Engines. These are of the single tandem double acting 4 cycle type, 2 of 600 b. h.p. and 3 of 850 b. h.p. The complete expansion principle embodies expansion of the burning charge and a low terminal pressure and temperature, with a consequent bettering of the working conditions, simplifying the cooling and lubricating features and decreasing the gas consumption by about 20 per cent. These engines bear the same relation to other gas engines that a condensing steam engine bears to a non-condensing steam engine in the point of steam economy.

THE OLD SAYING that "a prophet is not without honor save in his own country" usually holds good

in human experience, but the Liberty Mfg. Co. has recently sold right in its own city, Pittsburg, an order of 12 Liberty Twin Strainers to one of the big industrial concerns there, and this company bought the strainers because they knew from experience that the strainers were just what they wanted and would do the work required. It takes a good prophet to get honor in his own home town.

THE MURRAY IRON WORKS CO. of Burlington, Iowa, have just exported a complete power plant for a flouring mill in Tsingkiangpu, China. The shipment includes a Corliss engine, tubular boiler, heater, etc., all of the Murray make.

LAST NOVEMBER WE REFERRED in Practical Engineer to the fact that The Lunkenheimer Co., Cincinnati, Ohio, had received from the Panama Canal Commission a very large order for its Renewo globe, angle and cross valves. The order at that time covered upwards of 7,000 valves.

Within the past 2 weeks this company received an additional order for the Renewo valves, amounting, in all, to upwards of $50,000. This repeat order for this improved valve, from a discriminating purchaser such as the Canal Commission, tends to show that the merit of the device has been recognized, and the initial order must have opened up so satisfactorily that they thought it necessary, in spite of the severe competition and lower prices, to favor The Lunkenheimer Co. with their specification.

The Renewo valve has a renewable, self-cleansing seat, and the disk can also be replaced when worn. Owing to the ingenious construction of the seating faces, the seat will outwear many disks. It is not necessary in every case to replace these parts, as the regrinding feature is also embodied in the Renewo valve, so that if desired the seating faces can be reground and made tight without removing the valve from connecting pipes.

SAIVOIL, a new compound manufactured by the Steel Mill Packing Co., of Detroit, Mich., is a substance to be mixed with other lubricants, such as oil or grease, and is stated by the manufacturers to save 50 per cent of the oil. A gallon of engine oil is mixed with an ounce of the Saivoil and is stated to be as valuable as 2 gal. of the clear oil.

WANTED

"Positions Wanted" advertisements not exceeding 50 words for subscribers to Practical Engineer will be inserted twice free of charge. "Help Wanted" and special advertisements 25 cents a line.

POSITION

Wanted—Difficult work in construction engineering, where wages are gilt edge. Thorough in steam and gasoline and in machine erection. Good reference. Strictly sober and reliable. Will go any place in Southwest. Employed, 15 days' notice required. Address N. D. Newhouse, 1105 Georgia St., Los Angeles, Calif. 8-2

POSITION

By engineer employed at present in paper mill, wishes a change. Eleven years' experience in operating Corliss and slide valve engines and D. C. generators. Married, but no family. Address Box 110, Practical Engineer. 8-2

POSITION

Experienced gas engineer and producer operator with experience in operating rental station equipment, both A. C. and D. C. types, who is employed at present, desires change. Would prefer plant using natural gas. Address Box 109, Practical Engineer. 8-2

POSITION

Either as steam or gas engine engineer. Have first class Ohio license. Thoroughly acquainted with generators and motors and all modern power plant appliances. Best of reference as to character and ability. Address Box 111, Practical Engineer. 8-2

POSITION

By young engineer as chief engineer in small or medium size electric light or power plant, eastern Pennsylvania preferred. Now employed, but have reasons for change. Am no globe trotter. Married. For further information address Box 108, Practical Engineer. 8-2

POSITION

Young man, 22 years old, strictly sober, attentive and willing; machine shop experience, steam fitting, low pressure, firing, motors and light wiring, wishes position in engine room as helper or oiler, or in large manufacturing plant. Address R. Streller, 103 W. 80th street, New York city. 8-2

POSITION

Position of supervising and inspecting engines with large company. Am holding such position at present, having charge of power plants, machinery, etc. Making boiler and engine tests and having general supervision of plants and machinery. Address Box 107, Practical Engineer. 8-2

POSITION

By young man, 23 years old. Have 3rd class license for New York city, stationary and electrical engineer. Eight years' experience as steam fitter and general power plant mechanic, blacksmith and plumber. Strictly sober, man of family, guarantee services. Address Joseph E. Colwell, Orchard street, Ridgefield Park, New Jersey. 8-2

POSITION

By a steam, gas and electrical engineer of eleven years' experience, as chief in large or small plant. I have Illinois state license, first class references. Can get results with Corliss, gas or gasoline engines, motors and generators and make my own repairs from boilers up. Use indicator. Address R. Smith Cadwell, 202 Jeffery St., Kankakee, Ill. 8-2

POSITION

With manufacturing company having opportunities to enter sales department by M. I. T. graduate, 27 years old. Have had experience in both shops and drawing room with two large concerns manufacturing engines, pumps, condensers, electrical machinery, air compressors, mining machinery, etc. Employed; references. Address Box 106, care of Practical Engineer. 7-2

POSITION

As fireman in place of advancement, by man 29 years old. Employed 14 years in present position. Charles Nelson, 48 Cheerver place, Brooklyn, N. Y. 7-2

POSITION

As head engineer and electrician. Understand the business from coal pile to lamps. Can also run Vilter refrigerating machine and do inside and outside wiring, pipe fitting, etc. At liberty July 10th. Address P. E. C., Box 366, Shawano, Wis. 7-2

POSITION

As mechanical draftsman by graduate of draftsman's courses with some experience. Location, east, with promising concern. Familiar with gas engines; employed in shop. Will start as detailer or tracer until ability is demonstrated. Age 21; strictly temperate. Let me send specimen drawings, etc., immediately. Address Box 105, Practical Engineer. 7-2

FOR SALE

60 steel storage tanks, 6,000 gallons' capacity. Good as new. Double riveted, extra well built. Suitable for storage of oils, waters or liquids of any kind. 100 steam pumps. Get our prices on engines, boilers and electrical machinery. All sizes and kinds. Chicago House Wrecking Co., 35th and Iron Sts., Chicago. 4 tf

STEAM ENGINEERS'

Slide Rule. Gives M. E. P. for steam and air. Send fifty cents for full size working model, including coupon worth fifty cents. Address F. F. Nickel, 27 Winans street, East Orange, N. J. 8-tf

ENGINEERS

Pack your Corliss valve rods with Ideal Metallic Packing. Three years' guarantee. Price per inch diameter of rod $1.00. Ideal Metallic Packing Co., South Stillwater, Minn. 8-tf

ENGINEERS AND MECHANICS

To make big money selling Incomparable "ZIZ" Hand Soap. A 10-cent can will instantly remove more dirt and stains from the hands than four cakes of any soap made, and it will not injure the most delicate skin. Small sample free. Byram Mfg. Co., Box 3133, Boston, Mass. 4 tf

PATENTS

C. L. Parker, late Examiner, U. S. Patent Office, Attorney-at-Law and Solicitor of Patents. Patents secured promptly and with special regard to the legal protection of the invention. Handbook for inventors sent upon request. 186 McGill Building, Washington, D. C. 4 tf

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